RENOVATING THE

IVORY TOWER

Canadian Universities and the Knowledge Economy

David Laidler,
editor

C.D. Howe Institute

The C.D. Howe Institute

The C.D. Howe Institute is a national, nonpartisan, nonprofit organization that aims to improve Canadians' standard of living by fostering sound economic and social policy.

The Institute promotes the application of independent research and analysis to major economic and social issues affecting the quality of life of Canadians in all regions of the country. It takes a global perspective by considering the impact of international factors on Canada and bringing insights from other jurisdictions to the discussion of Canadian public policy. Policy recommendations in the Institute's publications are founded on quality research conducted by leading experts and subject to rigorous peer review. The Institute communicates clearly the analysis and recommendations arising from its work to the general public, the media, academia, experts, and policymakers.

The Institute was created in 1973 by a merger of the Private Planning Association of Canada (PPAC) and the C.D. Howe Memorial Foundation. The PPAC, formed in 1958 by business and labor leaders, undertook research and educational activities on economic policy issues. The Foundation was created in 1961 to memorialize the late Rt. Hon. Clarence Decatur Howe, who served Canada as Minister of Trade and Commerce, among other elected capacities, between 1935 and 1957. The Foundation became a separate entity in 1981.

The Institute encourages participation in and support of its activities from business, organized labor, associations, the professions, and interested individuals. For further information, please contact the Institute's Development Officer.

The Chairman of the Institute is Kent Jespersen; Jack M. Mintz is President and Chief Executive Officer.

C.D. Howe Institute
125 Adelaide Street East
Toronto, Ontario M5C 1L7
tel.: 416-865-1904; fax: 416-865-1866
e-mail: cdhowe@cdhowe.org
Internet: www.cdhowe.org

102-04350/

Renovating the Ivory Tower

Canadian Universities and the Knowledge Economy

edited by

David Laidler

Policy Study 37

C.D. Howe Institute

C.D. Howe Institute publications are available from:
Renouf Publishing Company Limited, 5369 Canotek Road, Unit 1,
Ottawa, Ontario K1J 9J3
phone: (613) 745-2665; fax: (613) 745-7660;
Internet: www.renoufbooks.com

and from Renouf's store at:
71½ Sparks Street, Ottawa (613) 238-8985

Institute publications are also available in microform from:
Micromedia Limited, 20 Victoria Street,
Toronto, Ontario M5C 2N8

This book is printed on recycled, acid-free paper.

National Library of Canada Cataloguing in Publication Data

Main entry under title:

Renovating the ivory tower : Canadian universities and the knowledge economy

(Policy study ; 37)
Includes papers presented at the annual meetings of the Canadian Economics Association.
Includes bibliographical references.
ISBN 0-88806-537-X

1. Education, Higher — Economic aspects — Canada. I. Laidler, David, 1938– II. Canadian Economics Association. III. C.D. Howe Institute. IV. Series: Policy study (C.D. Howe Institute) ; 37.

LA417.5.R46 2002 338.4'337871 C2002-900520-5

© C.D. Howe Institute, Toronto.
Quotation with appropriate credit is permissible.
Cover design by Leroux Design Inc.
Printed in Canada by Printcrafters Inc., Winnipeg, Manitoba
April 2002.

Contents

Foreword vii

Renovating the Ivory Tower: An Introductory Essay, by *David Laidler* 1
Outline of This Essay 2
Canadian Universities: Some Historical Background 3
The Standard of Living and the Knowledge Economy 6
What These Studies Establish 12
Interpreting the Evidence 19
Directions for Policy 28
Concluding Comment 35

Universities and the Knowledge Economy, by *Paul Davenport* 39
The Challenge of Accessibility and Quality 39
University Education and the Knowledge Economy 44
University Research, Innovation, and Globalization 49
Meeting the Challenge of Accessibility and Quality 54

Do We Have a Problem Yet? Women and Men in Higher Education, by *Stephen T. Easton* 60
Where Have the Boys Gone? 64
Demand: The Rate of Return on a Degree 67
Supply: The Number of University-Ready Students 75
Conclusion 78

The Global Talent Hunt and the Growth of e-Recruiting in Canada, by *Alice Nakamura and Joel Bruneau* 80
How e-Recruiting Works 81
Commercial e-Recruiting Services 86
Nonprofit e-Recruitment Services 89
A Private, Nonprofit Complement to e-Recruitment Services 92
The Evolution of Campus Career Placement Services 94
Questions Raised 96
Recommendations 98
Appendix: Canadian Postsecondary Institutions Partnered with Campus WorkLink 100

Comments on Davenport, Easton, and Nakamura and Bruneau, by *Melville L. McMillan* 105

Quantity or Quality? Research at Canadian Universities, by *John Chant and William Gibson* 125
Indicators of Research Performance 127
Research Performance, 1994–98 131
Performance Over Time 135
A Focus on Institutions 142
Conclusions 146
Appendix Tables 150

A Matter of Discipline: Early Career Outcomes of Recent Canadian University Graduates, by *Ross Finnie* 169
The Data 171
Setting the Stage: Distributions, Evaluations, Unemployment 175
Earnings 183
Conclusions 202
Appendix: The Earnings Models 209

The Returns to University Education in Canada, 1990 and 1995, by *François Vaillancourt and Sandrine Bourdeau-Primeau* 215
Literature Review 216
Methodology 216
Returns to Education 224
Conclusion 228
Appendix Tables 229

Returns to University Education in Canada Using New Estimates of Program Costs, by *Kelly Ann Rathje and J.C. Herbert Emery* 241
Benefits of Total Education 242
Costs 244
Total Rates of Return to University Education 245
Externalities 247
Private Rates of Return 249

Implications for Tuition Policy 252
Conclusions 252
Appendix A: Regression Results for
Canadian University Graduates 255
Appendix B: Costs 258

Comments on Chant and Gibson, Finnie, Vaillancourt and Bourdeau-Primeau, and Rathje and Emery,
by *Jeffrey Smith* 265

The Contributors 281

Members of the C.D. Howe Institute 285

Foreword

Change is the order of the day in the Canadian economy. The nature of many of the goods we consume and the technology used to produce them is in constant flux. Increasingly, too, the competition that Canadians face and the shocks to which our economy is exposed are international, rather than local, in scope and origin. Coping with this new economic environment and taking advantage of the opportunities it presents are a major preoccupation. Phrases such as "new economy" and "knowledge economy" have become commonplace in discussions of economic policy. Moreover, the welfare of Canadians is more than merely material, and our political and social institutions, and the values they embody, are also under constant pressure to evolve.

In such an environment, new ideas — and a highly skilled, adaptable, and creative labor force to implement them — are crucial to Canada's economic progress. A well-educated and thoughtful citizenry will ensure that economic prosperity underpins the growth of more general social and political well-being. Canada's universities are a major source of all these things, and policymakers concerned with designing measures to raise Canadians' quality of life must pay careful attention to them for that reason alone.

It is quite natural, therefore, that the C.D. Howe Institute, whose basic task is to provide well-informed and policy-relevant analysis of economic, political, and social issues, should pay attention to the current state of affairs in Canadian universities. To that end, the Institute organized two sessions dealing with these issues at the July 2001 meetings of the Canadian Economics Association held at McGill University in Montreal. This volume brings together the papers presented at those sessions in a more permanent form. Together, they provide an overview of the current state of play in Canada's universities. They discuss some the challenges these institutions now face and their success in meeting them, and they also offer suggestions about public policies that might make their contributions to Canadian life more effective.

These essays build on an already well-established academic literature, and it is hoped that, in their turn, they will become the basis for further research. But, as is always the case with C.D. Howe Institute publications, their authors have taken particular care to make their work accessible to a wider audience. Some of the essays deal with universities as producers of new ideas in their research function and as creators of educated and productive graduates in their teaching role; others take up certain quite specific problems they now face, created by the male/female balance of their student bodies, to give one example, or of managing aspects of the transition of their graduates to the labor force, to give another; still others discuss the extreme economic pressures Canadian universities have faced in recent years, and propose some remedies for the difficulties these have created.

In bringing this work to the attention of a broader audience than is usually reached by academic researchers, the C.D. Howe Institute hopes to promote a better understanding of the role of universities in the knowledge economy, and the way they are responding to the challenges it poses. It also hopes to promote discussion of how best to provide the resources needed for these institutions to remain efficient contributors to Canada's economic, social, and political life.

The book was copy edited by Ruth Crow, Elizabeth d'Anjou, Lenore d'Anjou, and Ron Edwards, and prepared for publication by Marie Hubbs and Barry A. Norris. As with all C.D. Howe Institute publications, the analysis and opinions presented here are the responsibility of the authors, and do not necessarily reflect the views of the Institute's members or Board of Directors.

Jack M. Mintz
Preseident and
Chief Executive Officer

Renovating the Ivory Tower:
An Introductory Essay

David Laidler

This volume derives from two conference sessions that took place at the Annual Meetings of the Canadian Economics Association in Montreal on July 2, 2001. At each session, three papers were presented and then subjected to critical commentary by a single discussant.

The first session dealt with aspects of the broader debate about universities: their role in the economy, including their influence on economic growth and their current funding problems (Paul Davenport); that long-standing cause for concern, the question of equal access for men and women to higher education (Stephen Easton); and the effects of technology on graduates' transition from university to the job market, including some implications of these effects for the "brain drain" (Alice Nakamura and Joel Bruneau). Melville McMillan acted as discussant.

The second session dealt more directly with Canadian universities' productivity both in research (John Chant and William Gibson) and in the creation of human capital (papers by Ross Finnie and by François Vaillancourt and Sandrine Bourdeau-Primeau). To these three papers has been added a fourth on the creation of human capital, by Kelly-Ann Rathje and Herbert Emery, based on work carried out by the former in the course of her graduate studies at the University of Calgary, which came to the editor's attention shortly after the conference. Jeff Smith provides a critical commentary on this group of essays.

I am grateful to Clark Leith, Melville McMillan, Bill Robson, Jeff Smith, and François Vaillancourt for comments on an earlier draft.

All these papers take an economic approach to describing the activities of Canadian universities. The appropriateness of doing so derives from the simple and unquestionable fact that these institutions use scarce inputs to generate valuable outputs. From the economist's viewpoint, the university sector is a capital-goods-producing industry, and is appropriately analyzed as such. Its output consists of knowledge and of people who comprehend that knowledge and are able to put it to use. Universities produce ideas, sometimes given the label *knowledge capital*, and they also impart skills to people, creating in the process what is usually called *human capital*. Economic analysis is not capable of providing a comprehensive treatment of universities' complex role in society, but the economic approach is helpful as far as it goes — and, in many respects, it goes a long way, as I hope this volume demonstrates. As we shall see, the picture that emerges is one of a system that, while still functioning rather well, is nevertheless showing some signs of stress.

Outline of This Essay

In this introductory essay, I first outline the historical and institutional factors that frame current debates about the place of universities in Canadian life. I then turn to a brief survey of their role in what has come to be known as "the knowledge economy," including some important caveats about certain currently fashionable ways of looking at this matter. I proceed to discuss the substantive findings of the studies in this volume, paying particular attention to what they reveal about the factual background that ought to inform public policy towards universities. Finally, I offer some suggestions of my own about the directions that policy in this area might take. They are not meant to be definitive but to provoke further debate about some vitally important questions.

Specifically, I argue the following:

- The currently healthy rates of return yielded by undergraduate education permit a significant shift toward tuition fee revenue as a source of finance for the sector.

- Such a move would force universities to become more responsive to students' own assessments of their often diverse needs, making them less reliant on funding from the government and business sectors, which seem to be taking a dangerously narrow view of the way in which these institutions contribute to Canada's well being.
- Any such move must be accompanied by measures to ensure that financial markets provide adequate access to funding for the accumulation of human capital.
- Such a change would not preclude government and business from continuing to support both the teaching and research functions of the university sector — indeed, a strong case can still be made for such support.

My suggestions have the practical aims of increasing the overall level of funding available to universities and reducing their reliance on any one sector for support.

Canadian Universities: Some Historical Background

Historians of the university have often told us that the institution's current complexity is the outcome of a number of tendencies that have long co-existed uneasily with one another. In some times and places, the creation, preservation, and transmission of cultural and, particularly, religious understanding have been the prime function of the university; in others, pure scientific research has taken pride of place. It is these traditional activities, both of which involve the pursuit of knowledge for its own sake, that underlie the metaphor of the ivory tower.

But universities have never operated in total isolation from the economy. They have provided not just pure research but useful knowledge that allows the community at large to enhance its material well-being, and they have trained young people in productive and marketable skills. In the 1960s, the word "multiversity" came into fashion (see, for example, Kerr 1963), characterizing what many seemed to think was a newly emerging complexity in the activities

expected of such institutions. But it is worth recalling that, even in the Canada of 1836, Victoria College (now part of the University of Toronto, but then in Cobourg, Ontario) was teaching surveying and navigation in addition to divinity, and that in so doing it was following an already well-established, nonconformist, and mainly US model (Cameron 1991, 12).

What is new about modern universities and has put them in need of renovation is neither the complexity of their offerings nor the potential for conflict among the constituencies they are expected to serve, but the sheer scale of their activities as both creators and purveyors of knowledge of all kinds. Populist impulses to broaden and expand their activities under government auspices were already at work in the nineteenth century, most notably, but by no means uniquely, in the United States, when the land grant universities, which now form the backbone of the state university system, were created by the *Morrill Act of 1862*.

World War II marked another major turning point in the development of the modern university. As Franklin (2000) notes, the war itself led to a huge expansion of government support for university research in science and engineering, not least where it might lead to military applications. The war's end saw student bodies expanded dramatically as ex-servicemen reentered civilian life. Thereafter, the Cold War in general, and US–Soviet competition in the wake of the 1957 Sputnik launch in particular, provided the motive for further expansion on all fronts. Canada, like virtually every other Western country, followed the United States' lead, with governments providing most of the necessary funds.

The Economic and Political Background to Current Debates

The rapid secular postwar growth in productivity that made all this university expansion, and much else, seem affordable slowed suddenly around 1973, but this fact was not obvious until a decade or more later. Canada, like other countries, is still living with the consequences of this slowdown and of the fiscal exuberance that preceded it and persisted for awhile even after its recognition.

These consequences extend far beyond the university sectors of all the countries affected, of course, but certain features of the Canadian landscape have made the pressures on universities here particularly acute, especially compared with those experienced by post-secondary institutions in the United States.

First, the resources needed to create, maintain, and expand Canadian universities have, from the outset, come predominantly from government. There are no Canadian equivalents of the great privately endowed US research universities such as Harvard, Chicago, and Stanford, or indeed of such smaller private institutions as Oberlin or Swarthmore, which tend to specialize in undergraduate teaching. In Canada, when governments feel short of funds (for good or bad reasons is not relevant to this point) and cut back on university spending, the reduction impinges on the whole sector, not just one segment of it. Furthermore, the existence of private universities in the United States not only cushions the effects of government cutbacks on the sector as a whole, it also provides competitive pressures that constrain the extent to which it is politically prudent to cut support to publicly funded universities.[1]

Second, as a direct, though surely unintended, outcome of the division of functions between the federal government and the provinces, and between the public and private sectors of the economy, Canadian universities compete directly and visibly with health care for public funding. Provincial governments are responsible for both services and, since 1977, funding in aid of these activities from Ottawa has been bundled into a single block grant. For any provincial treasurer, then, the opportunity cost of each dollar spent on universities is a dollar of health care expenditure. Given

1 Studies of the factors that systematically motivate university boards and administrations have mainly been concerned with US experience. This work strongly suggests that enhancing the prestige of the institution for which they are responsible, both absolutely and relative to that of others, ranks high among their goals (Winston 1999). Administrators of the major state universities are thus sensitive to competition emanating from their privately funded rivals, and respond to it. To some extent, they can influence politicians whose policies might undermine their ability to maintain their standing. Even so, many of the pressures currently being felt in Canada are also affecting US state universities. (See "Land Grant Universities" 2001).

the Canadian electorate's commitment to the public provision of health care and the fact that this sector directly serves the whole population rather than just one segment of it, not to mention the high political profile of its current financial difficulties, it is hardly surprising that higher education in general, and universities in particular, have come under increasing financial pressure.

Finally, the Canadian electorate remembers the fiscal excesses of the 1970s and 1980s and the measures that were needed to turn things around in the 1990s. It is in no mood to sanction any wholesale loosening of government purse strings without compelling arguments — an attitude unlikely to change in the near future. On the other hand, that same electorate seems unwilling to sanction any reduction in access to university education for young people.

As a consequence of these three factors, government funding has failed to grow in line with enrollments and there has been only a partial easing of restrictions on tuition fees, so that universities increasingly depend on funds raised from the business community to fill the resulting gap. Some may regret these facts and wish them different, and others may welcome them; but facts they are, and any practical discussion about policies toward universities must recognize them. Canadian universities are certainly under considerable financial pressure, as Davenport convincingly argues, but if they are to receive more resources, it must be shown that the money would be well spent. And if the resources are to come from government, it must be shown that there are good reasons the private sector cannot be expected to provide them.

The Standard of Living and the Knowledge Economy

A salient fact of North American economic life in the 1990s was that gross domestic product (GDP) per head of population grew faster in the United States than in Canada. It is a commonplace that this measure is not the be-all and end-all of economic and social well-being, but it is remarkable how much more attention people seem able and willing to pay to cultural and spiritual matters when their material comfort is well taken care of. So let us agree that "standard

of living" as measured by this imperfect indicator does matter and that when it tells us Canada has been falling behind its nearest neighbor and has begun to catch up only in the past two or three years, this is a cause for concern.

Productivity and Its Rate of Growth

Any country's GDP per head is, as a matter of arithmetic, the consequence of two factors: the proportion of the population that works, and the amount of output that each working person produces on average. In turn, the level and the rate of growth of GDP per head depend on the performance of the labor market and on the level and rate of growth of the productivity of labor. Sharpe (2001) demonstrates that both these factors (the labor market and productivity) contributed to Canada's failure to keep pace with the United States in the 1990s. In the first part of the decade, poor labor market performance, reflecting the depth of the 1991–92 recession and the slowness of the subsequent recovery, was the dominant factor at work; thereafter, labor productivity was the main culprit. As, for example, Davenport's Figure 11 shows, output per person-hour grew more slowly in Canada up until 1998, particularly in manufacturing.[2]

Within manufacturing, however, the productivity growth differential between the two countries has been concentrated in the machinery and electrical equipment sectors. The popular notion that the spectacular US economic performance of the 1990s was the result of developments in high-technology activities, is well grounded in fact (see Rao and Tang 2001). And because these activities involve using highly educated workers to exploit new developments in science and engineering, it is understandable that another popular notion has developed — namely, that the key to securing a rising standard of living at the turn of the millennium lies in the creation and dissemination of knowledge, particularly technologi-

2 As Davenport also tells us, recently revised data show that, since 1998, Canada's GDP and growth of GDP per capita have actually surpassed those in the Unites States. Productivity growth, however, as measured by output per person hour, has continued to lag. (See Little 2001.)

cal knowledge. The "new economy" is said to be a "knowledge economy," and within it, universities are often presented as having special roles to play as creators of new ideas in their research function and as producers of human capital capable of exploiting those ideas in their teaching function. In this way of looking at things, the output of universities is a vital input into the material progress of the market economy.

A Role for Universities

This vision of universities as primarily handmaids to material growth in a capitalist economy is quite horrifying to many within the Canadian academic community (see Turk 2000) — not entirely without cause, as we shall see in due course. It is important to recognize that some of the ideas universities produce do turn out to be valuable in the world outside their gates, that their graduates do possess superior productive powers acquired in the course of their education, that these ideas and powers do have value in the marketplace, and that the university sector's performance is likely to be judged by taxpayers according to these criteria. But it is equally important to insist that Canadian universities cannot simply be turned into engines of economic growth, nor should they seek political support by pretending they can be.

In order to clarify the issues at stake here, it is important first to distinguish between the factors influencing the economy's *level of productivity* and those influencing the rate at which that level *grows* over time. To the extent that a more educated and better trained labor force is able to produce more output because it embodies more human capital, the proportion of the economy's labor force that has received higher education affects the *level* of the economy's productivity as measured by output per person-hour of work. An increase in that proportion, therefore, will increase the level of the economy's productivity. Such an increase will enhance the *ongoing rate of growth of productivity*, however, only if this more educated labor force also turns out to be better at generating new ideas, each of which in turn enables more output to be wrung from a given level of inputs (including human capital). This latter possibility also provides the main economic justification for universities' involvement

in research and development (R&D) activity, as opposed to the mere transmission of already-existing knowledge.

Second, even if these possibilities are realizable in fact, they do not in themselves make a case for government involvement in promoting the knowledge economy by way of public expenditure on universities. As long as those who embody human capital obtained through university education can capture the returns this yields in the form of enhanced market incomes — including enhancements generated by new productive ideas that the possession of such capital enables them to create — and as long as there are no barriers to people investing in their own education in the first place, then the usual marketplace mechanisms should ensure that both the highly educated labor force and the font of new ideas are adequately supplied without public subsidies.

The Economic Case for Public Subsidies

In order to justify public intervention designed to increase expenditures on education and research beyond the levels private market activity would supply, the *social* returns to such intervention — particularly as they involve the effects of the creation and dissemination of ideas on the level of well-being generated by the economy and on the rate of growth of that well-being — must exceed the market incomes of those directly involved in these activities. Advocates of such intervention rest their case mainly on the claim that, once created, productive ideas become generally — and, to all practical purposes, freely — available to the economy at large, and can therefore be profitably exploited without any compensation for the original creators of those ideas.

If the *spillover effects* — often called *external benefits* or *positive externalities* — of education and research are indeed empirically significant, an economy that relies on market incentives alone to bring about investment in such activities will be inefficiently underprovided with them. To the extent that these education and research activities are located in universities, the case for supporting those institutions with public funds is made.

In recent years, proponents of so-called *endogenous growth theory* have argued that spillover effects are a significant engine of eco-

nomic growth and that they have been at work in, among other times and places, the United States in the 1990s.[3] It is easy to argue further that this mechanism for promoting growth can be imitated in Canada, to the great benefit of our living standards, if only government will provide the incentives for the acquisition of human capital, and its subsequent devotion to R&D activities, that market mechanisms are now failing to deliver in adequate amounts.

Some Caveats

These arguments seem to be plausible, particularly when applied to science and technology. But a few caveats are in order before anyone jumps to conclusions about the likely desirable impact on Canada's economic prospects of further investment of funds in universities in general, and in their science and technology programs in particular.

To begin with, there is the idea that statisticians call the *regression fallacy*. In the current context, it suggests that, among any group of countries at any time, the one that is performing best is probably performing above potential as a result of transitory factors quite beyond any policymaker's control. It is therefore likely to perform less well in future. Consistent with this idea is evidence that formulas for economic success seem to be extraordinarily difficult to transfer across national boundaries or even to sustain in working order at home for very long. Over the past 40 years or so, there have been periods when the Swedish, French, and Japanese "models" seemed to be just the thing for any economically ambitious country to imitate, but we do not hear much about these anymore. It might well turn out, therefore, that the US model of productivity growth based on scientific and technological education and research will prove no more durable.[4] If the United States has been performing

3 For a comprehensive, albeit highly technical, account of this area, see Aghion and Howitt (1997).

4 François Vaillancourt reminds me that, in recent Canadian discussion, the US model has run into some competition from the Irish model. The same warning applies to the latter.

above its potential over the past decade, then the results of Canada's seeking to reproduce that level of economic growth by making large investments in the production of scientific knowledge and technically skilled human capital might turn out to be disappointing. (Then again, Canada itself could be the lucky recipient of a random boost to economic growth!)

Furthermore, when economists look behind national data on productivity growth rates to information gathered at the level of individual industries, they find a great deal of diversity. This result is completely consistent with what we know about the narrow industrial base of US productivity growth in the 1990s, and at first sight there is nothing particularly disturbing about it. It is, however, less widely known and much more discomfiting that even more specific research, at the level of individual firms or even individual plants, finds that this huge diversity in productivity performance persists. That is why Harberger (1998) likens the appearance of productivity growth — to which he prefers to give the more down-to-earth label "real cost reduction" — to the isolated sprouting of mushrooms as opposed to the generalized rising brought about by yeast. This striking simile captures the fact that, rather than having an across-the-board effect on all aspects of an economy's performance, the ideas that drive productivity growth seem to raise output by very different amounts at different times, often in widely scattered places. Interspersed among the expanding plants and firms in industries where productivity is improving rapidly on average are to be found many where it is stagnant or even declining.

These facts suggest that the implementation of productivity-enhancing and, hence, real-cost-reducing, measures is very much a scattered and localized activity rather than one whose effects involve the general application of new ideas that radiate out from specialized "knowledge factories" to the economy at large. Those who bring about such cost reductions may well be exploiting knowledge created outside of their own establishments, but there is clearly a large element of local insight and ingenuity involved in discovering and exploiting their productive potential. It is hard to interpret the facts of real-world productivity growth as corresponding to the generalized productivity-growth spillovers that variables with names such as "knowledge" or "education" bring about in

modern endogenous growth models. They suggest, indeed, that these models, for all their *a priori* appeal, are intellectual artifacts that fail to explain some key properties of productivity growth data as we are beginning to understand them.[5] This does not, of course, imply that knowledge and education are unimportant to economic well-being, or that universities do not create valuable ideas and educate productive graduates. It does, however, warn us that no one has yet shown that these mechanisms generate general external benefits on any significant scale. In our current state of knowledge, we ought to be extremely skeptical of popular arguments for the public subsidization of scientific and technological research in universities as a sure-fire method of raising Canadians' standard of living.

What These Studies Establish

These important caveats notwithstanding, the studies in this volume clearly demonstrate that Canadian universities are productive institutions on even the narrowest of economic criteria. If there are good reasons to question their capacity to act as engines of material growth, there can be little doubt about three other matters: that they make a major contribution to sustaining the level of Canadians' living standards; that the right policies can enhance this contribution; and that the wrong policies can undermine it.

Returns to Human Capital

The concept of human capital has been central to the economic analysis of education for about 40 years now (Teixera 2000), so the papers by Finnie, Vaillancourt and Bourdeau-Primeau, and Rathje

5 As Mark Blaug, a leading expert in the economics of education, recently remarked:

> Where is the evidence that human capital generates externalities that makes growth endogenous? While the new growth theory has raised a lot of interesting technical ideas relating to the influence of economies of scale, externalities, R&D and so on, none of these are ever pinned down very precisely. (1999.)

and Emery are additions to an already well-established tradition in economic research, in Canada as elsewhere. All three investigate the returns to investment in university education, all three are particularly interesting in that they do so on a discipline-by-discipline basis, and, as Smith points out, none yields any major surprises to anyone already familiar with this line of work. But when matters of economic policy are at issue, it is critical to get, and keep, the facts straight, and the facts that emerge from these studies, or that are confirmed by them, throw important light on some currently contentious issues, and considerably strengthen our faith in the factual basis that ought to underlie any serious discussion of them.

To begin with, as Davenport points out, there has recently been a tendency for some commentators to argue that the economic value of university education in general, and of undergraduate education in the social science and humanities in particular, has been declining. It might be added that such views may also have influenced some Canadian politicians in their decisions about university funding, though Davenport offers no conjectures about this. The results presented by both Finnie and Vaillancourt and Bourdeau-Primeau suggest that there was no serious evidence to support these views, at least down to the mid-1990s. Whether one considers the private returns — measured purely in terms of subsequent wages and salaries — students realize on their own investment of time and money in education, or the broader social returns that also take account of the public subsidies they receive while in university and the taxes they pay when working (and that, hence, are particularly relevant to policymakers), undergraduate education seems to have been a profitable undertaking for both the individuals receiving it and for society in general in those years.

Rathje and Emery's results complicate this picture, however, with rather lower estimates of the returns to education than those of Vaillancourt and Bourdeau-Primeau. The differences here stem from two main sources. First, Rathje and Emery's estimates for the private returns to university education are based on more up-to-date measures (tuition fee data for 1998) of the costs students incur in undertaking education. It is evident from their results that the increase in tuition fees that had then recently taken place had a notable impact on reducing the private returns to education. Second,

their estimates for the total returns exclude income from self-employment in measuring the incomes of graduates, whereas Vaillancourt and Bourdeau-Primeau include income from this source. For reasons that both sets of authors explain, excluding such income completely probably leads to a downward bias in rate-of-return estimates, while including it creates an upward bias. Thus, between them, these studies provide lower and upper bounds to the range within which such returns probably lie.

It is significant that all three studies show that the returns, both private and total, realized by educating women are distinctly higher than those accruing to the education of men. In certain areas, in fact, notably fine arts and the humanities, the returns to men seem to fall below any reasonable benchmark that might be applied in any market test of whether the investment is worthwhile. It also seems to be the case that the returns realized in the early years of employment are higher on average, for both men and women, in certain "harder" (that is, more mathematically demanding), disciplines, such as engineering and natural sciences, and in professional areas, particularly those in commerce and health sciences, than they are in the arts and humanities. In addition, as Finnie's work shows, graduates in some subjects at the "softer" end of the spectrum take longer to get established in the labor market. Since it is often argued that university education would be of more social value were it more directly aimed at preparing its recipients for the job market, these results are of considerable interest.

On the other hand, Finnie also shows that labor market disadvantages for humanities graduates seem to disappear within a few years of graduation, and, crucially, that there is no sign that graduates' satisfaction with their studies is lower among those educated in the humanities and social sciences than in other fields. Moreover, Davenport presents data on student loan default rates that show these to be much lower for university students than for college or private vocational school students, whose education is, on average, much more directly aimed at preparing them for the labor market. And it is worth noting that even Rathje and Emery's results show that, when sex differences are averaged out, rates of return to undergraduate education in all fields (except fine arts), whether private or total, remain attractively high. Taken overall, these con-

siderations argue against jumping to the conclusion that the return to an education more narrowly directed to preparation for the job market is so much higher than the return to other courses of study that a major reallocation of resources is called for.

None of these results will come as a surprise to anyone familiar with earlier work on the economics of universities. Nor will it be a surprise that both Vaillancourt and Bourdeau-Primeau and Rathje and Emery conclude that the returns to graduate work (again as measured purely by salaries) are in most areas, particularly at the PhD level, on the low side or even negative. It is a necessary implication of the productivity of undergraduate education that the costs of graduate study are very high in terms of forgone earnings, and it is this fact that largely drives the results in question. Furthermore, many PhDs work in universities, where salary levels are relatively low but the *equalizing differences* (as economists call them) that arise from the working environment are widely agreed to be quite attractive. There is, however, some disagreement about just what these differences are. Outside universities, one sometimes encounters disparaging comments about professors who use the protection afforded by academic tenure as a means of consuming more leisure than other, less fortunate, members of the labor force. Within universities, the talk is more likely to be of the opportunities afforded for research and scholarship.

Research Productivity

The essay by Chant and Gibson throws some light on this vexatious issue, for it is a path-breaking attempt to compare the research productivity of the best-performing Canadian universities, mainly in science and technology, with their US counterparts. Its results are easy to summarize, but perhaps a little harder to interpret.

The most productive Canadian universities compare very well indeed with their US counterparts as far as the quantity of research (as measured by numbers of papers published in learned journals) is concerned. But when it comes to the impact of that research, as measured by the frequency with which those papers are subsequently cited, they compare less well. Since the data used in this study mainly derive from scientific and technological disciplines,

the biases that naturally arise from the lack of interest of the US academic community in many issues in the humanities and social sciences that concern Canadians — and, hence, the infrequent citation by US researchers of Canadian work in those disciplines — are likely to be minimal. The main difficulty in interpreting these results arises from the fact that the US universities whose research is widely cited are overwhelmingly those large, well-endowed private institutions to which there is no Canadian counterpart. It is a commonplace of the anecdotal evidence on these matters that Canada has neither universities as good as the best nor as bad as the worst in the United States, so it comes as no surprise that the University of Toronto, which ranks at the top among Canadian institutions, fares relatively poorly compared with, say, Stanford, as far as the impact of its research is concerned.

Some Problems in the Sector

Even so, it would be a mistake to conclude that all is well with Canadian universities and that the ever-shrinking budgets Davenport describes have had no effect on their performance. The data analyzed by Finnie, Vaillancourt and Bourdeau-Primeau, Rathje and Emery, and Chant and Gibson are inevitably backward looking. In the main, they tell us about how well the sector was performing up to the mid- to late 1990s, and although budgets had been tightening for some time even then, they have tightened still further in subsequent years. It is therefore important to be alert to any signs of current stress revealed, or even hinted at, in the studies collected together here.

Attention has already been drawn to the significant disparities in the returns to university education earned by men and by women; Stephen Easton deals with material bearing on this matter. He presents compelling evidence that universities now admit significantly more women than men, whereas 25 years ago men were in the majority. Just as the shortfall in women's enrollment levels a quarter-century ago perhaps implied that they were failing to achieve their full educational, and, therefore, economic potential (among other things), so the shortfall among men now has the same implications. Given that these tendencies are at work in an economy that, as

Davenport shows, already educates a significantly smaller proportion of its population to university level than does the United States, they are disturbing — and all the more so because the missing men are not going into the college sector but seem to be moving straight out of high school into segments of the labor force where rewards are already low and still declining.

Easton suggests that women university graduates earn a labor market premium over high school graduates that exceeds the one accruing to men, that this premium has been increasing, and that the increase in the university enrollment rate of women relative to that of men, therefore, may reflect a relative growth in demand for university-educated women. This conjecture is certainly consistent with the results discussed earlier. McMillan, however, citing work by Riddell and Sweetman (2000), questions whether the premium accruing to women has indeed been rising, and suggests that what we are seeing here might better be interpreted as a supply-side shift. Easton does provide some preliminary information on one factor that might be at work on the supply side in the shape of data he interprets as suggesting that high schools are currently doing a better job of preparing women for further education than they are of preparing men for it. But if this is indeed the case, then this fact, in turn, needs to be explained. It is hard, therefore, not to sympathize with McMillan's view that the facts about women's increasing enrollment in universities, and their relative success once enrolled, may have altogether deeper social causes that lie well outside of the educational system. There is a major puzzle here that requires further investigation.

Things are more clear-cut in the case of the labor market problem that Nakamura and Bruneau document. They argue that the technical properties of the electronic systems now widely used by US-based employers in the process of recruiting university graduates entail economies of scale that give these recruiters advantages over their Canadian counterparts, and that these advantages in turn accrue to potential US employers of high-caliber Canadian graduates, thus making a contribution to the "brain-drain." To summarize their case at some risk of oversimplifying it, US recruiters can add the résumés of Canadian job seekers to the lists their US clients search at a low marginal cost, which their Canadian com-

petitors cannot match for their Canadian clients. Hence, information about Canadian job seekers becomes more cheaply available to potential US employers than to Canadian employers, particularly to smaller firms.[6]

As McMillan suggests, it is easy to dismiss the concerns that Nakamura and Bruneau express with phrases such as "welcome to the market." In the increasingly integrated North American economy, big "buyers" of highly trained graduates are more likely to be found in the United States. It thus pays recruiting services to cater to them, and it is understandable that Canadian graduates respond to the incentives that result from these facts. But as McMillan also notes, there is a little more to it than that.

Nakamura and Bruneau suggest that the problems they document have arisen as unintended consequences of the withdrawal of the Canada Manpower agency from university campuses and its replacement by local placement services that, because of universities' funding problems, are often supported on a cost-recovery basis. It goes without saying that there should be no barriers to emigration in a free country, but it is surely anomalous that Canadian firms, whose taxes help to support Canadian universities, are at a disadvantage *vis-à-vis* their US competitors when it comes to recruiting their own country's graduates. How large and significant this problem might be is hard to say on the basis of currently available information, but it would surely be worth further study.

One other notable hint of stress in the Canadian university system emerges. Although the public perception has long been that there exists a large oversupply of well-educated PhDs ready and willing to fill any university teaching vacancies that might occur in

6 As Nakamura and Bruneau tell us, systematic evidence on the extent of this problem is not available. For what it is worth, conversations with the placement service at my own university reveal that an increase in the number of US firms approaching graduating students whose résumés they had found while scanning electronic databases has been noted in recent years. This activity, which was described as "low level" relative to the overall scale of the placement service's operations, seemed to be concentrated in the high-tech sector and had become less frequent in 2001, when that sector was contracting. This anecdotal evidence is consistent with Nakamura and Bruneau's fears of a "selective brain drain."

Canada, there is overwhelming anecdotal evidence that this is not in fact the case. Certain disciplines are under considerable competitive pressure when it comes to faculty recruitment and retention as a result of the interaction of budgetary stringency with a strong demand for their practitioners in the United States. This has been the case for many years in areas such as computer science and economics, not to mention in certain specialities, notably finance, that find their home in business schools. It has, however, been hard to say whether these pressures have had seriously adverse effects on standards of research and teaching. Although business schools are not singled out for special attention in the studies in this volume, Chant and Gibson do document an apparent relative decline in the quantity and quality of research emanating from Canadian universities in computer science and economics, and Finnie finds evidence of a significant decline in satisfaction with their education among economics graduates (particularly women). One cannot help but wonder whether we are seeing the first signs of declining academic standards in Canadian universities that will spread further across the system with time as their budgets get ever tighter relative to those of their US counterparts.

Interpreting the Evidence

At first glance, the results on returns to university education presented in this book seem to support popular conceptions about the role of universities as contributors to productivity growth in a knowledge economy. At the undergraduate level, these returns, however they are measured, seem quite respectable in all but a few cases, and they are higher in, for example, science, engineering, health sciences, and commerce than in other areas. Three points, however, need to be considered before jumping to any conclusions about the desirability of encouraging further expansion in these and related fields.

Human Capital and Productivity

As was argued above, it is important to distinguish between the effects of higher education on the *level of productivity*, and those on

its *rate of growth*. There is no reasonable doubt that university education in most areas significantly increases the level of its recipients' productivity and, hence, indirectly the level of Canadians' standard of living. This is the effect that Finnie, Vaillancourt and Bourdeau-Primeau, and Rathje and Emery all measure. But none of these studies seeks or provides evidence that university education endows its recipients with human capital that enables them to contribute to the generation of economy-wide productivity growth over time. It might do that, but we do not have any hard evidence that it does. There is some empirical basis for arguing that the provision of university education in Canada on a larger scale than exists now might create a step-up in the level of labor productivity in the economy. The evidence — presented by Vaillancourt and Bourdeau-Primeau and by Rathje and Emery — that undergraduate education yields high rates of return in most areas, combined with two facts Davenport documents — the relatively high number of Canadians receiving college as opposed to university education, and the lower returns accruing to the former — are highly suggestive here. However, we do not have any evidence that such a change would contribute to the economy's ability to grow at a faster rate.

In any event, the returns to university education to which the evidence in this volume pertains are those captured as income by the individuals who received that education. Where the returns to human capital accrue solely to the individuals in which that capital is embodied, then one should presume that those individuals are intelligent enough to respond appropriately to the investment incentives they provide without the aid or encouragement of government. The fact that returns are, on balance, higher in science and technology fields and in professional programs than in arts and humanities in no way changes this conclusion. If there is any validity to the widely held perception that mathematical abilities differ among potential university students, then it is likely, as Smith wisely points out, that students who are relatively well endowed with them will choose areas of study where those abilities can be exploited. The returns to those who have already chosen such disciplines might indeed be higher, perhaps substantially so, than those observed elsewhere; but, crucially, those returns will also be higher than the returns that would be realized by any less mathematically adept

people who shifted into these areas. Indeed, since there is no evidence of a general shortage of university places in these high-return areas, the presumption must be that the students who currently could, but do not, enter them, must perceive the expected returns that face them as being no more, and perhaps less, than those in the fields they do indeed enter.

The evidence on the productivity of human capital presented in this book is, then, at least as supportive of the case for setting undergraduate tuition fees at levels that would cover all the costs of providing teaching services and then letting potential students make their own choices about whether and what to study, as it is of the argument for expanding the level of public funding of such institutions. Indeed, Auld (1996), among others, has already made a case along just these lines for permitting private universities to operate in Canada. To point this out, however, is by no means to argue for a complete withdrawal of government from the university sector. Quite apart from these institutions' research functions, not to mention the provision of postgraduate education, there is still the question of how best to enable undergraduates to pay the costs of their education. I discuss these matters below.

The Social Returns to University Education

The studies in this volume do not specify, let alone quantify, any returns to human capital that accrue to society at large over and above the market incomes earned by the individuals in whom it is embodied, But this fact does not mean that such returns do not exist — indeed, the case for public subsidies to university education rests heavily on the claim that such returns do exist. Subsidies are indeed ubiquitous in Canada. This matter therefore requires further discussion.

Here, it is worth recalling at the outset that Canada, as with every other advanced country, makes lower levels of education compulsory up to a certain age and provides education free to all recipients up to the end of high school. That these arrangements are utterly uncontroversial surely suggests that the value to society of having all its members educated up to a certain level is so high, and

is so generally perceived to be high, that we are willing to set aside the rights of families to make unconstrained choices in these matters. It also suggests that education beyond the compulsory minimum is perceived to yield external returns that are large enough to warrant society at large bearing a significant fraction of its cost.[7] Two points follow from this. First, it is extremely unlikely that the apparently large external benefits education is so widely believed to yield disappear entirely as the transition between the secondary and postsecondary sectors is made; second, it is, therefore, understandable that society by and large seems to take for granted a large public sector role in postsecondary education — indeed, to support it.

Nevertheless, to apply economists' standard cost-benefit calculus to the design of an economically efficient scheme of subsidies to university education that takes account of these external benefits, it would be necessary to quantify and put a cash value on them. The prospect of even attempting to do this has long made economists acutely uncomfortable. Vaillancourt and Bourdeau-Primeau follow Stager (1996) in noting that the external benefits to society flowing from university education, whose nature they leave undefined, might be quite large, but that, because those benefits seem to be unmeasurable, there is nothing more to be said on the matter. In this, they follow a long tradition among economists. West (1988), for example, suggests that arguments in this area tend to be about "atmospheric effects" on such things as social cohesion, and concludes that they ought to be downplayed, while Blaug reports that "no one has ever been able to quantify the externalities from higher education in Britain, or for that matter anywhere else" (1999, 331).

Smith (in this volume) conjectures, however, that economists find externalities in this area hard to discuss simply because they have not paid much attention to investigating them systematically. After all, the externality economists call "pollution" was once hard to discuss, before a research literature developed to deal with its

7 The reader is reminded that forgone income is an important component of the cost of education; therefore, providing tuition-free education does not render it costless to its recipient.

quantification and the design of mechanisms to cope with it. The fact that economists have yet to undertake serious work on a problem does not necessarily mean that it is unimportant. We simply will not know how economically important are the external benefits flowing from university education until some serious work on the question is done.[8] In this respect, Rathje and Emery's approach to the issue is of particular interest. Instead of trying to measure external effects directly, they ask how large these effects would have to be to bring rates of return in areas of study where the pecuniary benefits are low up to a benchmark level. They then speculate as to whether the subsidies implicit in these estimates seem "reasonable." There is, of course, a strong subjective element to the final step of this exercise, and readers will have to make up their own minds about whether or not they agree with Rathje and Emery's particular judgments. But the authors' approach to this issue is, to my knowledge, original, and it is surely useful as a way of organizing further thinking about these matters.

I suspect, however, that, once they venture beyond the narrow field of productivity spillovers, economists need help from other disciplines to advance their understanding of the wider social benefits of education in general, and of university education in particular. Such matters as the nature of the society in which we want to live, our relationships with fellow citizens, the obligations we feel toward them, and the ethical importance we attach to various features of societal arrangements are all at stake here. It is sometimes claimed by, for example, university teachers of the humanities and social sciences that important general benefits are conferred on a democratic society by those who can think critically about and discuss coherently competing value systems and their implications for social and political issues. The trouble with trying to subject claims of this type to conventional economic analysis is that the toolkit economics uses to evaluate externalities measures costs and benefits in

8 Smith has drawn my attention to a study by Barth (2001), who, using Norwegian data, looks at the influence on individuals' productivity, as measured by wages, of the average level of educational attainment of the workers in the establishments where those individuals are employed. Barth finds that influence to be significantly positive.

terms of given "tastes" on the part of the population. It is hard to see how such a metric can be used to put a value on activities whose purpose, in part, is to examine and perhaps modify those very tastes, particularly in a society where diversity in such matters is itself accorded a significantly positive value. But to say that the issue is beyond the scope of economic analysis is not to deny its social importance.

Research, Productivity, and Spillovers

Universities create knowledge as well as educate students, and the type of knowledge they create is often said to be, by its very nature, a public good, the entire benefit of which is available freely to all, and for which there is no feasible way of charging. Such a good confers all of its benefits on the whole of society, and it may be usefully thought of as representing a limiting case of a positive externality. Furthermore, such a good would not be produced by a private, for-profit enterprise. Hence, so the argument goes, there is a straightforward case for public subsidies to those who engage in the search for knowledge for its own sake.

The archetypical example of a public good, much used in the economics textbook literature, is national defense, and to have persuaded US legislators in the late 1950s that universities contributed so much to its production that they would be worthy beneficiaries of a *National Defense Education Act* was a stroke of opportunistic genius on someone's part. Nowadays, there is little mileage to be had from this particular argument, even in the United States, let alone Canada. It has, as we have seen, been replaced by the claim that knowledge, scientific and technical knowledge in particular, is the key to increasing national prosperity, and, therefore, that its generation by researchers must have government support. It has already been pointed out that there is room for skepticism in the face of this argument.

Recall, first of all, Harberger's (1998) study, discussed above, which looks for, but does not find, signs of economy-wide spillover effects on productivity growth, emanating perhaps from the general expansion of knowledge. Here too, it is also worth drawing attention to such work as that of Zucker, Darby, and Armstrong (1998) on

more localized spillover effects. They study the interaction between research carried out in California universities and the activities of nearby firms in the biotechnology sector. That such interaction has been important is beyond question, but apparently it has not involved generalized spillover effects. The results of university-based research in this area were not public goods available for anyone in the vicinity of their creation to exploit. Rather, there were collaborative efforts between identifiable university researchers and specific firms, with these firms rewarding the researchers in question for their efforts with private income.[9] These findings confirm the theory that basic science yields economically productive applications, but they provide no support for its public subsidization. On the contrary, they suggest that private markets provide adequate incentives to get basic science done and then applied.[10]

On the other hand, the evidence just cited comes from one particular industry, and it may be that, in other areas, there are indeed significant scientific and technical ideas of great productive potential that do quickly become common knowledge and generate spillovers. In that case, public subsidies to their production would seem to be justified. There is, however, a trap in this argument. As we are so often told, Canada operates in a "global" economy, and shares a border with the most productive economy in the world. If Canada is ambitious about improving its productivity performance by exploiting new ideas that really do generate substantial external effects on productivity growth, it has a cheaper alternative to subsidizing the production of such ideas at home. It can simply take a free ride on research results produced in the United States, which, by common consent, already has the most intellectually fertile university system the world has ever known.

---

9 This paper is not an isolated effort, but a recent product of an ongoing research agenda. Its results are typical of those its authors and various associates have obtained in other studies, many of which are listed in its bibliography.

10 This result should not perhaps be surprising, because it has long been understood that, to the extent ideas can be protected as trade secrets, or patented, the returns they yield can be captured by their originators. There is no reason those who can establish rights to exploit the fruits of research in this way should expect anyone else to pay for it.

Externalities and Current Policies

Recent initiatives at the federal level in Canada, notably the Centres of Excellence and Canada Research Chairs programs, suggest that the argument outlined above has not been accepted in policy-making circles; and perhaps there are, after all, other external effects that would justify these programs.

For example, it is sometimes suggested that externalities arise not just from university research itself, but also from public confidence in the independence and integrity of those who carry it out. From this perspective, even knowledge that *can* be patented and privately exploited confers more benefits if it is the outcome of disinterested research and remains in the public domain. James Turk, clearly intending his argument to apply well beyond the bounds of research in science and technology, puts the matter as follows:

> [T]he university's mission is the unqualified pursuit and public dissemination of knowledge and truth. The university serves the broad public interest by treasuring informed analysis and uncompromising standards of intellectual integrity. (2000, 3.)

This statement has considerable merit as a justification for disinterested public participation in the funding of research, but the operative word here is *disinterested*. Governments, no more willing than any other agents to remain at arm's length from the activities they fund, increasingly seek to influence the direction those research activities take.

It is worth noting, furthermore, that governments themselves nowadays often encourage the formation of "partnerships" between universities and private sector agents with a view to producing and then sharing the revenue generated by commercially exploitable ideas. Turk (ibid.) and his associates are particularly critical of such arrangements — rightly so, in view of the criteria they bring to bear on the matter. But they perhaps pay insufficient attention to the general threat to the integrity of universities that is bound to arise whenever they become too dependent on any single source of revenue, be it public or private. It is not clear to me that the integrity of the research activities of a university sector that attracts a signif-

icant proportion of its funding from multiple partnerships with private agents is under greater threat than one that relies for its support on public expenditures for strategic initiatives designed by politicians and bureaucrats. These considerations suggest that arm's-length arrangements are just as important for ensuring the integrity of government funding of research as they are in the case of the private sector.

A second argument about the external benefits created by the public funding of universities reveals an apparent contradiction in certain current policies. That argument has it that such benefits are generated not just by ideas, but also by the presence in a community of the individuals who generate them. People capable of excellence in research (as in other endeavors), so the argument goes, are a desirable ornament to any self-respecting community, and Canada is poorer if they do their work elsewhere, even if its results take the form of an immediately available public good whose material benefits Canadian free riders can readily exploit. If this argument is compelling, however, it suggests that we ought not to tolerate (as Smith notes) restrictive salary agreements in our universities, particularly those that are unionized, that make it impossible for them to compete with their US counterparts for truly excellent personnel. It also suggests that immigration restrictions that give privileges in the academic job market to merely competent citizens and landed immigrants over outstanding foreigners are damaging to Canada. Excellence, like misery, loves company, and if we restrict immigration so as to discourage the employment of excellent foreign researchers in Canada, we should not be surprised to find that excellent Canadians emigrate to the United States to work with them there. It is, therefore, a small step in the right direction that such restrictions have been relaxed a little.

Note finally, however, that some of the above arguments, notably those about opportunities for free riding on research done in other countries, apply best to technical and scientific subjects. It is one thing to take a free ride on scientific and technical research done elsewhere, but another altogether to try the same trick with the outcome of scholarly work in the humanities and social sciences. Scientific and technical truths do not change at national borders, but a country that relies on another jurisdiction to do its critical thinking

for it on matters of values, and of their application to social questions, will in due course end up with no values or distinctive policies of its own, and will cease to be a distinct entity. As with the creation of human capital, so too with the generation of new ideas: the case for public subsidies to Canadian universities is at least as strong in the humanities and social sciences as it is in science and technology. Here, too, the fact that conventional cost-benefit analysis seems not to apply implies a great deal about the limitations of that technique but nothing at all about the intrinsic significance of the problem.

Directions for Policy

Current policy toward universities in Canada seeks to provide broad access to undergraduate education by imposing stringent limits on fees. Against this background, it seems to favor scientific, technical, and professional fields over others when it comes to funding research and postgraduate study. At the same time, Canada's postsecondary education policy actively encourages a deeper involvement of business in the work of universities as a means of funding both research and teaching. Overall, this policy stance is not well justified by what we know about the economics of the matter, and I now turn to making some suggestions for change. Let it be clear that, in doing so, I do not intend to implicate the authors of subsequent essays in this volume as advocates of specific measures. These authors can and do speak for themselves on the issues raised by their own studies.

Tuition Fees and Loan Guarantees

First and foremost, note that the returns accruing to recipients of undergraduate university education in Canada are comfortably positive in most areas, even when full account is taken of the subsidies students currently receive. Vaillancourt and Bourdeau-Primeau argue on the basis of 1995 data that there was then room for a significant increase in tuition fees, a conclusuion that, as Rathje and Emery show, still holds in light of 1998 data. The only area of under-

graduate study where a significant increase in tuition fees could not be absorbed by students is fine arts.[11]

There is no reason to believe, therefore, that the system could not continue to function even if all restrictions on the fees universities charge were removed and courses of study were priced, along lines suggested by Davenport (1996), to reflect the costs of providing them. Such a step would make undergraduate students, rather than government and business, the principal source of funding for universities. They would, therefore, become the principal arbiters of what programs are offered, on what scale, and at what levels. The demand for well-educated workers seems to be still growing in Canada, and some catching up to the United States remains to be done in terms of the proportion of the population receiving university education, despite the fact that such training is already a good deal more costly to obtain south of the border. It is therefore doubtful that the increases in Canadian tuition fees implicit in this proposal would lead to an absolute shrinkage in the demand for university places. It might well lead to some significant reallocations of resources within universities, however, as students began to take more careful note than they do now of the relationship between the resource costs of various programs and the returns they can be expected to yield. It is hard to believe that the overall outcome would be anything other than an improvement in the university sector's efficiency as a producer of human capital.[12]

One important condition must be satisfied to make any such deregulation of tuition fees desirable, a condition called for by considerations both of economic efficiency and of equity. Government

11 Note however, that their calculations involve rates of return in which sex differences have been averaged out. This is appropriate, for universities could hardly charge different fees to men and women. At the same time, a move to tuition fees based on the costs of education would likely lead to some movement of men among disciplines, and perhaps out of university education altogether.

12 To the extent that students themselves were paying for undergraduate education, the potential, noted by Nakamura and Bruneau, for electronic placement services inadvertently to transfer resources from Canadian taxpayers to US employers would be reduced or even removed altogether. I am grateful to François Vaillancourt for this point.

must ensure that lack of access to funds for education does not shut any otherwise qualified and willing applicant out of the university system. Potential students who are already in possession of sufficient resources could use them to buy an education offered at its market price, but in the absence of some sort of intervention, the less wealthy would face a serious barrier arising from the simple fact that private sector financial institutions do not usually make loans without collateral. Since indentured labor is, with good reason, illegal, any loans in aid of the purchase of higher education that they would be likely to offer in the absence of government intervention would go only to those who do not need them.

There is an obvious case for repairing this important gap in the private capital market by, at a minimum, having government provide guarantees in lieu of collateral to institutions making educational loans. The reader who wonders whether this has not already been tried and found wanting is reminded that what is being advocated here is support for *university* education, and Davenport's evidence shows that the default rate in this area has been low under current arrangements. Advocacy of the general principle of making student loans readily available should not be read as support for any specific program. This is an area where many devils lurk in the details, and there is not space here to deal with them.[13]

The Role of Subsidies

Those who believe there are important social payoffs to university education will continue to favor its further support by outright public subsidies. The considerations that would justify such measures involve, as has already been noted, fundamental social and political values not amenable to economic analysis. They must, then, be debated and dealt with through political processes — and, since

13 Here the reader's attention is drawn to Finnie (2001), who provides a careful analysis of the advantages of loans over grants as means of making post-secondary education accessible, and of the virtues (of which there are many) and shortcomings of the system currently in place, together with suggestions for improving it.

the questions at stake are of national significance, there is a clear role for the federal government in coping with them.

If the outcome of these deliberations is, however, a decision in favor of tuition subsidies, the arguments advanced above for giving market power to individual students still stand, suggesting that subsidies should be given directly to those individual students rather than to provincial governments or university administrations to be spent on their behalf. They could, for example, take the form of cash grants or of interest subsidies for student loans; the tax subsidies currently offered in registered educational savings plans (RESPs) also conform to this principle.[14]

Since we know so little about how the value of the external benefits that would justify public subsidies varies across areas of study, it would probably be best to distribute them in proportion to student enrollments in various disciplines, thus ensuring that public support for universities does not become a covert means whereby governments divert their activities away from the mix that their customers desire. This would happen automatically if federal subsidies were given to individual students by way of vouchers, independent of their chosen fields of study. However, other donors, including individuals, firms, and industry associations, not to mention provincial and local governments, should be left free to endow scholarships and to offer other support in particular areas as they see fit, subject only to the willingness of the university in question to accept what is offered. In this way, organizations that believe certain lines of study produce human capital of a type that yields particular benefits to them can pay for its production if that seems to be in their self-interest. And universities, ever mindful of the need to attract paying students, can be expected to be vigilant against gifts that arrive with conditions attached whose implementation would undermine the integrity of their programs of study.

14 One form of subsidy that seems to have much popular support would make the repayment schedules for student loans contingent on income earned after graduation. See, however, Smith's penetrating discussion in this volume of the perverse incentives implicit in such schemes.

Graduate study presents a no more complicated set of issues. For most professional programs, arrangements similar to those suggested for undergraduates should work without problems.[15] For those closer to the purely academic end of the spectrum, there might be more difficulties, but to the extent that the low material returns revealed by the Vaillancourt and Bourdeau-Primeau and Rathje and Emery studies are compensated for by intangible rewards, this would not be the case. Besides, if most PhD recipients go into university teaching, and if university revenues are to be mainly driven by undergraduate fees, then market mechanisms will work to ensure a level of reward necessary to maintain a supply of suitably qualified teachers. Even so, in the current state of knowledge, we should not rule out the possibility canvassed by Rathje and Emery that there are substantial externalities to be realized at this level that would justify the public provision of postgraduate scholarships and other forms of support.

Research Funding

Chant and Gibson suggest that universities use their research performance as a means of signaling to potential students the quality of the education they offer. To that extent, there is a case for funding research expenditures out of tuition revenue. By and large, university teachers enjoy research and other scholarly activities, and will choose to work at institutions that provide them with the time and resources to engage in them, through such means as lighter teaching loads and access to research assistants (who are usually drawn from the graduate student body).

15 Rathje and Emery's results on rates of return to medical education present a special problem in this context. To the extent that the low returns they estimate simply reflect a measurement bias stemming from the omission of self-employment income, they can be ignored. To the extent, however, that they reflect the effects of the organization of Canada's health care system, they suggest either that changes need to be made to that organization with a view to increasing the incomes of medical practitioners, or that the education of those practitioners requires subsidies. This issue raises questions far too complex to be addressed here.

If these benefits have to be paid for out of undergraduate tuition revenues, the ultimate judges of which academics will enjoy them will be their students. Professors who neglect undergraduate teaching in order to pursue research will not last long in such a system, and there can surely be no complaint about that. It might be objected that such arrangements would prove difficult to implement in institutions where faculty are unionized, and that universities constrained by such arrangements would be hard put to compete with those that are not subject to them. One can only respond that, if this does turn out to be the case, unionized institutions will be forced to contract, to charge lower fees for the services of lesser teachers, or to change their ways. It is hard to see why such an outcome would be anything other than desirable.

As with the creation of human capital, particularly at the postgraduate level, there are strong arguments that pure research and scholarship yield important social benefits. But, as I have argued, in this realm conventional economic analysis is, by its very nature, of only limited help in providing quantitative estimates of their value. Furthermore, policies regarding public funding of university-based research and its scale are also political matters of national importance, and similarly need to be debated and settled in the federal political arena. Current economic knowledge nevertheless yields two important lessons for such decisions. First, it would be unwise to premise them on productivity-growth spillover effects, the existence of which is extremely dubious. Second, if research productivity in universities is, like productivity elsewhere, a matter of "mushrooms" rather than "yeast," then public support for research would be better concentrated on researcher-initiated and curiosity-driven projects than, as at present, on centrally designed strategic initiatives.

Philanthropic private sector support ought, of course, to be part of the picture here, too. It ought to continue to be possible for firms and industries to pay for research that will be beneficial and profitable to them, subject to whatever restrictions the universities themselves see fit to place on such arrangements. Universities that come to rely more heavily than they now do on tuition fees paid by students, who will be concerned about the integrity of the institutions they attend, can be expected to take care to defend that

integrity. To this end, it would be a matter of simple self-interest for universities to ensure that all research contracts, whether with government or the private sector, be open to public scrutiny, and that no restrictions be placed on the publication of results generated under their auspices.

The Political Context

Universities are currently a provincial responsibility, but the forgoing arguments lead to the suggestion that provincial financing take on a secondary role in supporting a system that draws its basic revenue from tuition fees, supported by federal government guarantees — and perhaps subsidies — in a student loan market, as well as from subsidies to research that emanate from both the federal government and the private sector. Something, therefore, needs to be said about the political feasibility of such a rearrangement of financial responsibilities.

Note first of all that there is no suggestion here that the provinces surrender their statutory authority over universities or the right to continue subsidizing them if they see fit. The major change advocated is that they stop using their regulatory powers to hold down fees below the levels that universities themselves would like to set. Given that there is immense pressure on governments at all levels to increase health care spending, that universities compete directly with health care in provincial budgets, and that Ottawa's grants in aid of these two sectors are bundled together into the Canada Health and Social Transfer, there is perhaps room for a federal-provincial agreement that would see the provinces deregulate university fees in exchange for the creation of a federal loan guarantee system, with the resulting public expenditure savings being partly devoted to health care funding. In this way, overall government expenditures at both levels could be cut, spending on a popular program could be increased, and a new and more secure tuition revenue base could be provided for the funding of the important, but not so politically popular, university sector. The matter is surely worth some further thought along these lines.

Finally, it would do no harm if there were freedom of entry, subject to a minimum level of oversight designed to prevent outright

fraud, into the provision of university education. This again is an area where the provinces could use their powers without incurring expenditure obligations. In this case, there is no need for federal-provincial or interprovincial cooperation. Each province can experiment with what it does and does not approve. The recent and continuing growth of online universities in Canada has, in fact, already moved us a long way toward freedom of entry in this sector, at least as far as its teaching function is concerned. In saying that this is a positive step, I should not be read as approving of the specific programs offered by particular institutions, some of which, to judge from their websites, are heirs apparent to the organizations that used to advertise on matchbooks in the days when more people smoked.[16] I only mean to express the belief that the weaker ones among them will soon be weeded out by market forces, while the stronger ones will prevent the exploitation of monopoly power by existing institutions over particularly lucrative lines of business.

Concluding Comment

In this essay, I have highlighted the major results presented in the papers that follow, and tried to extract a coherent policy message from them as a whole. The main thrust of this message is easily summarized.

First, Canadian universities are productive institutions, but they have problems that need addressing. Some of these — the relative dearth of male undergraduates, and their relatively poorer performance — are probably not of their making; others — the influence of e-recruiting on their job-placement efforts — are quite specific and can be addressed in isolation. Still others, however, stemming both from methods and levels of funding, are system wide, and

16 Thus, I have considerable sympathy with Noble's (2000) opinions on the merits of these institutions. His comparison of modern internet-based "distance learning" initiatives to earlier efforts in this area that involved correspondence courses is revealing and, in many respects, compelling. I differ from him in having more faith in the capacity of prospective students to make informed choices among the better, worse, and downright fraudulent courses that are offered.

attract considerable attention because of the presumed importance of both education and research to the rise of Canadians' standard of living. Universities are undoubtedly major players in the knowledge economy, but their role stems from two facts: the majority of their graduates have useful skills that command high salaries; and the universities produce ideas that sometimes have social importance, including the potential to contribute to the economy's output.

Current public policies toward universities seem to be premised on the belief that their activities in teaching and research, in addition to the private benefits they confer, also spin off public goods capable of enhancing the economy's rate of productivity growth, the supply of which can be increased by government subsidies to a subset of their activities. This subset is concentrated in the science and technology area, where government encouragement of cooperation with the private sector is also being touted as a source of such spillovers. Unfortunately, the empirical basis for this belief is weak, and the thrust of current policies may well be misplaced.

A more realistic perception of the role of universities focuses on their well-established capacity to produce both human and knowledge capital that yields significant private returns. It follows that making use of the incentives implicit in this role would bring about an enhancement of their performance. To harness these incentives, universities must become more responsive, not to government but to their students, and the way to do that is to make those students the universities' principal source of revenue. A national educational loan program that eliminates capital market impediments to the implementation of such a change ought, therefore, to be a high priority. It may prove impossible to move policy all the way in the directions suggested in this essay. Nonetheless, current policies, some of which seem to be moving in the opposite direction, are probably rendering Canadian universities less, rather than more, efficient contributors to the knowledge economy.

References

Aghion, P., and P.W. Howitt. 1998. *Endogenous Growth Theory*. Cambridge, Mass.: Massachusetts Institute of Technology Press.

Auld, D. 1996. *Expanding Horizons: Privatizing Universities*. Toronto: University of Toronto Press.

Barth, E. 2001. "External Effects of Education? Evidence from the Wage Structure." Paper presented at a Workshop on Skill Needs and Labour Market Dynamics, Wissenschaftszentrum, Berlin, November 8–9. Oslo: Institute for Social Research. Mimeographed.

Blaug, M. 1999. "Mark Blaug." In B. Snowden and H.R. Vane, eds., *Conversations with Leading Economists: Interpreting Modern Macroeconomics*. Cheltenham, UK: Edward Elgar.

Cameron, D. 1992. *More than an Academic Question: Universities, Government, and Public Policy in Canada*. Montreal: Institute for Research on Public Policy.

Davenport, P. 1996. "Deregulation and Restructuring in Ontario's University System." *Canadian Business Economics* 4 (July–September): 27–36.

Finnie, R. 2001. "Measuring the Load, Easing the Burden: Canada's Student Loan Programs and the Revitalization of Canadian Postsecondary Education." *C.D. Howe Institute Commentary* 153. Toronto: C.D. Howe Institute.

Franklin, U. 2000. "What Is at Stake." In J.L. Turk, ed., *The Corporate Campus: Commercialization and the Dangers to Canada's Colleges and Universities*. Toronto: James Lorimer.

Harberger, A.C. 1998. "A Vision of the Growth Process." *American Economic Review* 98 (March): 1–23.

Kerr, C. 1963. *The Uses of a University*. Cambridge, Mass.: Harvard University Press.

"Land Grant Universities: An Old Dream in Trouble." 2001. *The Economist*, June 2–6, pp. 29–30.

Little, B. 2001. "Canada plays catchup despite solid growth." *Globe and Mail* (Toronto), August 13, p. B6.

Noble, D.F. 2000. "Digital Diploma Mills: Rehearsal for the Revolution." In J.L. Turk, ed., *The Corporate Campus: Commercialization and the Dangers to Canada's Colleges and Universities*. Toronto: James Lorimer.

Rao, S., and J. Tang. 2001. "The Contribution of ICTs to Productivity Growth in Canada and the United States in the 1990s." *International Productivity Monitor* 3 (Fall): 3–8.

Riddell, W.C., and A. Sweetman. 2000. "Human Capital Formation in a Period of Rapid Change." In W.C. Riddell and F. St-Hilaire, eds., *Adapting Public Policy to a Labour Market in Transition*. Montreal: Institute for Research on Public Policy.

Sharpe, A. 2001. "Determinants of Trends in Living Standards in Canada and the United States, 1982–2000." *International Productivity Monitor* 2 (Spring): 3–10.

Stager, D. 1996. "Returns to Investment in Ontario University Education 1960–1990, and Implications for Tuition Fee Policy." *Canadian Journal of Higher Education* 26 (2): 1–22.

Teixera, P.N. 1999. "A Portrait of the Economics of Education, 1960–1999." In R.E. Backhouse and J. Biddle, eds., *Towards a History of Applied Economics*, annual supplement to *History of Political Economy* 32. Durham, NC: Duke University Press.

Turk, J.L., ed. 2000. *The Corporate Campus: Commercialization and the Dangers to Canada's Colleges and Universities*. Toronto: James Lorimer.

West, E. 1988. *Higher Education in Canada*. Vancouver: Fraser Institute.

Winston, G.C. 1999. "Subsidies, Hierarchy and Peers: The Awkward Economics of Higher Education." *Journal of Economic Perspectives* 13 (Winter): 13–36.

Zucher, L.G., M.R. Darby, and J. Armstrong. 1998. "Geographically Localized Knowledge: Spillovers or Markets?" *Economic Inquiry* 36 (January): 65–86.

Universities and the Knowledge Economy

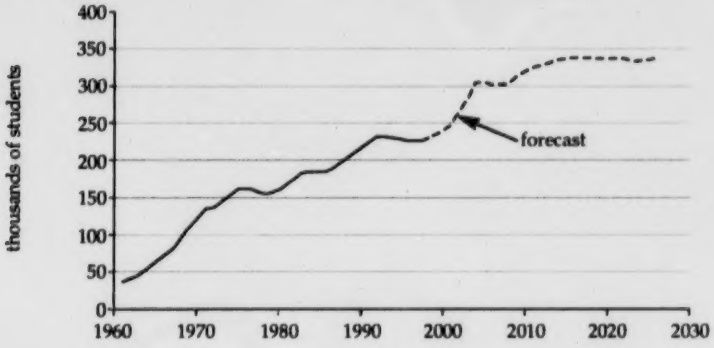
Paul Davenport

One of the striking attributes of the advanced economies during the past three decades has been the strong growth in demand outside universities for university graduates and university research. This long-term trend reflects the transition toward a knowledge economy, in which formal education, lifelong learning, and fundamental research are central to economic progress. All levels of education are important to the knowledge economy, and Canada's public schools and extensive community college systems all are worthy of our attention and support. My focus here is on universities, which, through advanced education and research, have a special role in allowing Canadians to take full advantage of the new economy.

The Challenge of Accessibility and Quality

Canadian universities will face an extraordinary challenge with respect to accessibility and quality over the next decade as the children of the postwar baby boomers reach university age, producing the third great surge in university enrollments since 1945. The first surge involved the returning veterans in the late 1940s and early 1950s. The second was the baby boom itself in the 1960s. In Ontario, for example, university enrollments increased by nearly 100,000 from 1961 to 1971. For the 1998–2010 period, current forecasts indicate an increase of some 80,000 (see Figure 1). The increase in the 1960s was associated with a significant investment of public funds, much of it for massive increases in faculty and staff, believed to be

Figure 1: ***Full-Time University Enrollment, Ontario, 1961–2026***



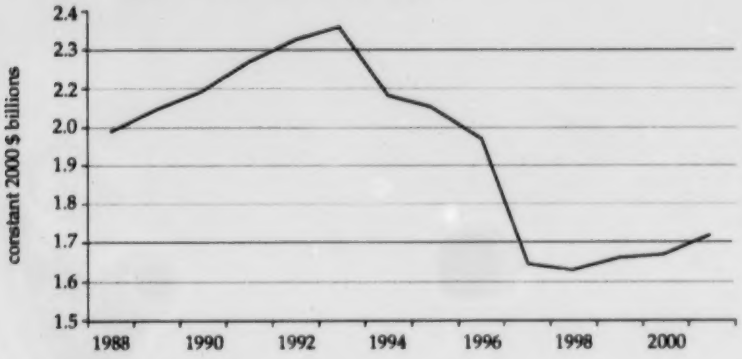
Source: Council of Ontario Universities.

essential to maintaining quality as enrollments rose. Are we ready to maintain quality in the same fashion in Canada during the coming decade?

Judging by the policies of the past decade, there is no reason for confidence in our ability to meet the accessibility challenge. In Ontario, for example, recent years have seen severe cuts in real university operating funding (see Figure 2). University budgets have declined throughout Canada, while US states have increased their funding of state universities, creating a growing divergence in the funding of public universities in the two countries. As Figure 3 shows, during the past two decades, real public operating funding per student in public universities has fallen by 30 percent in Canada and increased by 20 percent in the United States. Revenue per student is nearly 40 percent greater in US public universities than in Ontario, with core public funding, tuition, and fees per student all significantly higher in the United States (Figure 4). The comparison is done with a purchasing power parity rate for the Canadian dollar of 82 cents US, well above the official exchange rate.[1] An

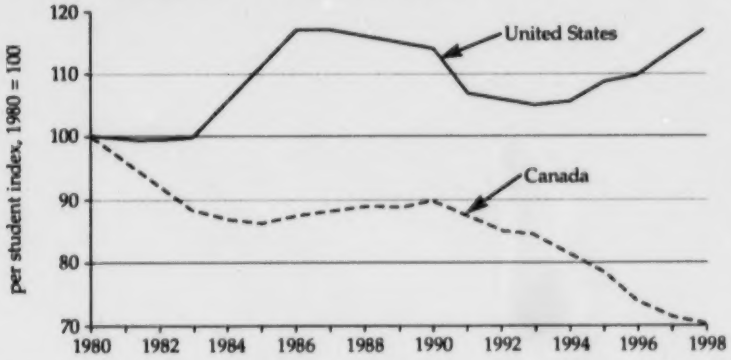
1 Note that in Figures 3, 4, and 5 I compare Canadian universities to such US state universities as Ohio State and Rutgers, not to the elite private universities such as Harvard or Stanford, which would have resources per student many times those in the public universities.

Figure 2: ***Provincial Operating Grants to Ontario Universities, fiscal years 1987/88 to 2000/01***



Source: Council of Ontario Universities.

Figure 3: ***Real per Student Public Funding of Public Universities, Canada and the United States, 1980–98***

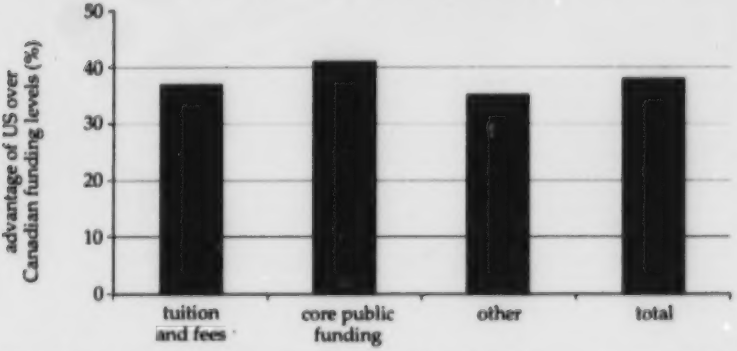


Note: Data for 1998 are estimates.

Source: Council of Ontario Universities.

immediate result of these differences is the growing inability of Canadian universities to compete for faculty with US universities. The competition is most intense in areas where private demand for faculty is also high, such as business and economics, electrical engineering and computer science, and certain areas of medical research.

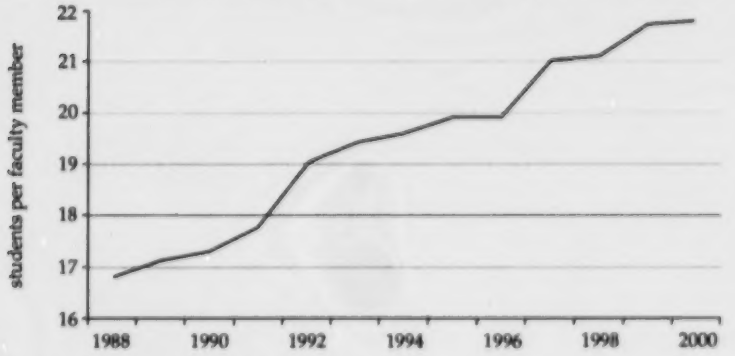
Figure 4: ***Revenue per Student in US Public Universities relative to Ontario Unversities, by Funding Category, fiscal year 1997/98***



Note: Assumes purchasing power parity for the Canadian dollar equal to 82 cents US. US data are from 11 states.

Source: Council of Ontario Universities.

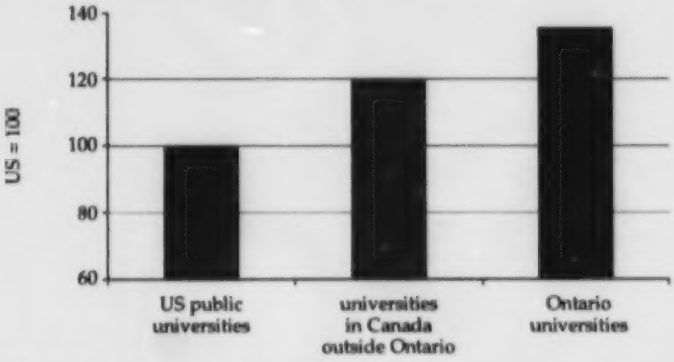
Figure 5: ***Ratio of Full-Time Students to Full-Time Faculty, Ontario Universities, school years 1987-88 to 1999-2000***



Source: Council of Ontario Universities.

The cuts in real operating funds have led to a growing student-faculty ratio in Canadian universities. Figure 5 shows the situation in Ontario, where the student-faculty ratio has increased by some 25 percent since the 1987–88 school year, an extraordinary change in just over a decade. The result has been larger classes, less contact between faculty and students, and what both students and faculty

Figure 6: ***Relative Student-Faculty Ratios, Public Universities, Canada and the United States, 1998***



Source: Council of Ontario Universities.

experience as a decline in educational quality. Again, the comparison with US public universities is instructive. Figure 6 shows that the student-faculty ratio is some 30 percent higher in Ontario than in the United States, and some 20 percent higher in the rest of Canada. The superior funding in US public universities allows for a higher quality of education for students and better salaries and working conditions for faculty, thus contributing to the brain drain of outstanding academics to the United States.

One approach to the accessibility challenge in Canada over the coming decade would be simply to allow the student-faculty ratio to continue to increase. In Ontario, for example, where it has increased by 25 percent, there has been no great public outcry. Larger class sizes, unlike dramatic crowds at emergency wards or growing waiting lists for surgery, do not dominate our political debates or provide leading stories for the evening news or the morning paper. Who really cares if the student-faculty ratio goes up another 25 percent in the next decade? Canada could adopt what might be termed the "barn model" of university accessibility. As long as you get in the barn and eventually get a degree, you receive all the benefits of university education — what goes on in the barn is not really very important.

I believe that the barn model is wrong — wrong for students and wrong for society. Students do need a high-quality education if they are to compete effectively in the knowledge economy, and quality does require the student-faculty interchanges that are reduced as the student-faculty ratio grows. Moreover, all in our society benefit from the innovation and productivity that well-educated university graduates help to create. To explore these themes, we need to review the role of university education in the knowledge economy.

University Education and the Knowledge Economy

Evidence of the growing importance of the knowledge economy comes in large part from the relative growth and superior remuneration of highly educated persons in the workforce. The number and proportion of university graduates in the labor force has risen dramatically over the past four decades, with no corresponding decline in their relative income. If the nineteenth century was marked by a strong demand for physical capital in the form of buildings and machines, the twentieth century saw a growing demand for the intangible capital represented by education and research. In the words of two distinguished US economic historians, in the twentieth century "the bias of technological innovation has been intangible capital-using, and, in particular has increased the relative demand for human capital formed through investments in education" (Abramovitz and David 1996, 44). This is a broad definition of the importance of education in the economy, not limited to any particular sector of economic activity. Finance Minister Paul Martin made this point very clearly in a January 17, 2001, speech to the Canadian Society of New York: "The volatility of the dot-com craze notwithstanding, the spread of technological change will continue to drive economic growth in all sectors.... [T]his is where the true new economy is to be found."

Too often, however, reference to the knowledge economy is given an overly technological definition — as meaning that the economy is now almost entirely driven by the changes in information technology that have occurred during the past three decades.

I do not hold that view, although I think that changes in such technology have been crucial to the development of the knowledge economy.[2] Rather, I believe that, to understand the knowledge economy, we must focus first on people and organizations, not on technology, still less on a particular technology. Learning in organizations has two fundamental characteristics — it involves the ability to learn and the ability to interact with and learn from others. These abilities are at the heart of an individual's success in the knowledge economy.[3]

With regard to teaching and learning, the knowledge economy generates a strong demand for university graduates because of the very nature of scholarly activity in a university. Universities are special places because learning takes place in an environment of research and scholarly innovation. Non-university institutions may well play a growing role in conveying facts and basic skills to young people after high school. As important as facts and basic skills are, however, the knowledge economy sets a higher premium on the ability to learn continuously, to take risks, and to work in teams — the very abilities universities cultivate because of their special position of teaching in a research setting.

For a decade, the Conference Board of Canada has asked its members to describe the skills they seek in university graduates. The skills they identify do not focus on information technology but instead are those of the knowledge economy. Canadian companies are looking for graduates with the ability to communicate clearly both orally and in writing, work effectively in teams, think critical-

2 On information technology and productivity, see Davenport (1997); a shortened, English version of that article is in Davenport (1998). Taking a 60-year perspective from 1970 to 2030, new materials and biotechnology may prove to be as important to the economy as information technology. On new materials, see Ball (1997); on biotechnology, see Thackray (1997).

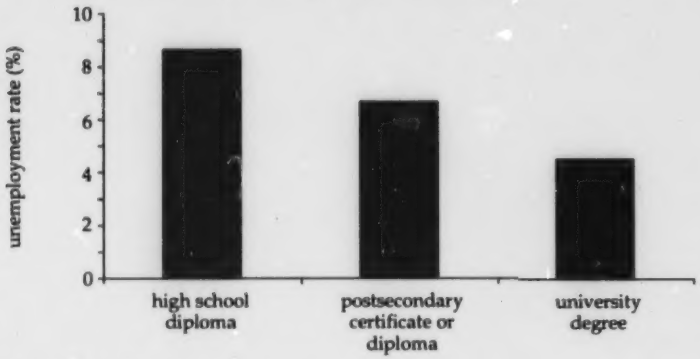
3 P. Senge, founder of the Center for Organizational Learning at MIT's Sloan School of Management, demonstrates the importance of learning with numerous company case studies (see Senge 1990). My view of the knowledge economy follows that of the business writer who popularized the term, Peter F. Drucker (1993). Thirty years before Drucker, Machlup (1962) set out some of the key issues.

ly and creatively, solve problems, and exercise leadership. Learning these skills requires the debate and discussion typical of small classes. Students who spend virtually all their time in very large classes will be shortchanged on this crucial part of their learning experience. The "barn model" of accessibility just does not work for the real needs of students in the knowledge economy. Thus, as we discuss the accessibility of university education, we need at the same time to ensure quality — and that must involve stopping the steady climb in the student-faculty ratio.

The high return to university education, for the individual and for society, is a central tenet of belief in the United States but is still poorly understood by some in Canada. Writing in the *Financial Post* in 1998, Diane Francis asserted that "[t]he public is beginning to realize a technical education at a college or vocational school is considerably more valuable than more university degrees." While Ms. Francis refers to an opinion survey conducted in Ontario in 1998, she does not examine any real data on employment and income, and with good reason: all the official data we have for decades show the superior labor market performance of university graduates. Using her comparison of college and university graduates, the data show that university graduates have lower unemployment rates (Figure 7), higher incomes (Figure 8), and lower rates of default on student loans (Figure 9). As Figure 9 shows, the 1999 default rate for private vocational schools in Ontario — institutions whose only purpose is their presumed close connection to the labor market — was 31 percent, nearly four times the university rate of 8 percent.

Those holding Ms. Francis' view of universities often retreat into one of three positions when confronted with the data on the economic outcomes for university graduates. Some claim that, although the average economic returns of university graduates may be superior to returns of colleges and vocational school graduates, those with degrees in the humanities and social sciences have inferior economic outcomes. In fact, liberal arts graduates do better than college and vocational school graduates, as the work of Allen (1998) and others has demonstrated. A second defensive position holds that, whatever the rates of return, we already have a higher rate of university participation in Canada than in the Unit-

Figure 7: ***Unemployment Rate, by Educational Level Attained, Canada, 1997***



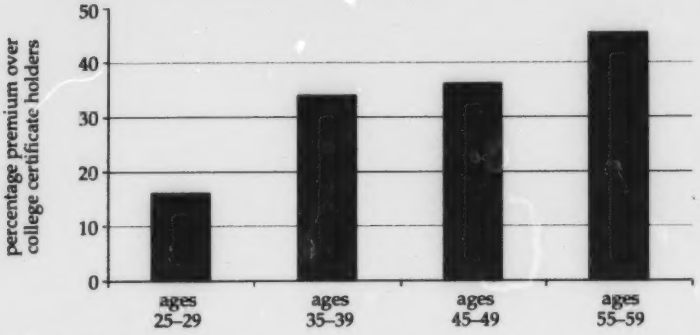
Source: Council of Ontario Universities.

ed States.[4] This common misunderstanding arises from data from the Organisation for Economic Co-operation and Development (OECD) on "tertiary education," which lump all postsecondary education into one category. While university education has a certain similarity among countries, non-university tertiary education varies widely among countries. As Figure 10 shows, Canada lags well behind the United States in the percentage of the labor force with a university degree, with the major European countries a bit behind Canada. This country is alone, however, in the extraordinary investment it makes in non-university postsecondary education, much of it training that is undertaken in the private sector elsewhere.

A third position is sometimes suggested, often by specialists in the area — that increased schooling is undertaken by those with

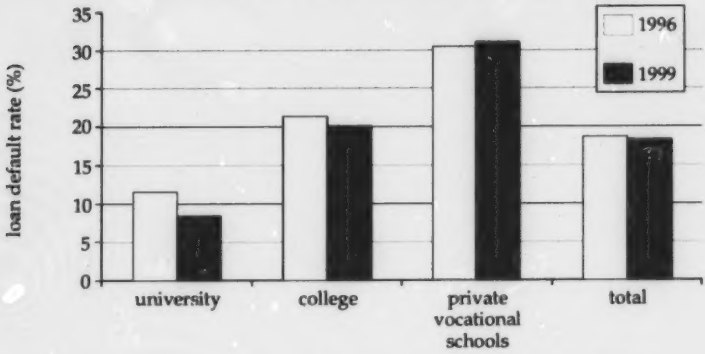
4 Riddell and Sweetman (2000, 86) refer to this as the "over-education/under-employment" view of higher education, which "implies that the rising educational attainment of many Canadians is a waste of their and society's time and money." The notion here is that we already have too many university graduates and that they are generally working in jobs that do not require higher education. Riddell and Sweetman find (p. 135) that their evidence contradicts this view and is more consistent with a growing demand in the economy for highly educated workers.

Figure 8: ***Income Premium for University Graduates, by Age Group, Canada, 1998***



Source: Statistics Canada.

Figure 9: ***Student Loan Default Rate, by Type of Postsecondary Institution, Ontario, 1996 and 1999***

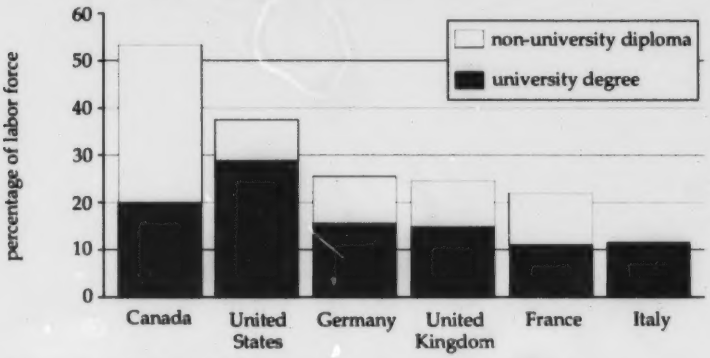


Note: Loans are those provided under the Ontario Student Assistance Program.

Source: Council of Ontario Universities.

greater innate ability, and it is the ability and not the schooling that explains their higher incomes. Ashenfelter and Krueger (1994) confront this position with evidence on schooling and income for identical (monozygotic) twins, and conclude not only that schooling is an important determinant of income, but that past studies may actually have underestimated the economic returns to schooling.

Figure 10: ***Share of the Labor Force with a Postsecondary Degree or Diploma, Selected Countries, 1996***



Source: Organisation for Economic Co-operation and Development.

In the event, parents and high school students in Canada have not been much affected by the gloom and doom of those skeptical of university education. They are aware of the high rate of return to university education, and have continued to drive up university enrollments over the past decade despite significant increases in tuition.[5]

University Research, Innovation, and Globalization

Growth in the knowledge economy is founded on discovery and innovation, in which university research has a central role. There will continue to be debate in all advanced countries about the balance between fundamental and applied research in universities and the appropriate degree of public funding for each. It is vital to understand, however, that it is precisely the distance of universities from the market which makes them such valuable collaborators with competitive firms in the knowledge economy. When the dis-

5 During the past decade in Ontario, tuition as a proportion of operating expenditures has risen from about 10 percent to about 33 percent, a figure similar to that of the early 1950s.

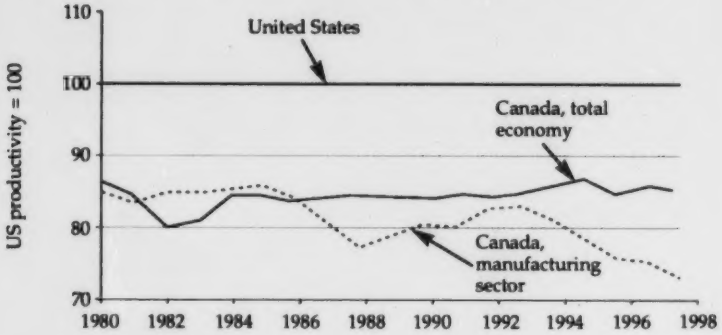
coveries of fundamental research run dry, the innovative companies of the private sector have no fuel in their pipelines. While technology transfer and industrial collaboration are important, if universities ever lose the focus on basic, fundamental research, the knowledge economy as a whole will suffer.

In his New York speech, Mr. Martin listed with pride the massive federal investments in recent years in support of university and hospital research, citing the Canada Foundation for Innovation, the Canada Research Chairs, the Canadian Institutes for Health Research, and Genome Canada. The provinces have also supported research. Ontario, for example, has invested hundreds of millions of dollars through the Ontario Research and Development Challenge Fund, the Ontario Investment Trust, and the Premier's Research Excellence Awards. These investments have made a profound impact on our ability to undertake research in Canada, to retain some of our best faculty, and to keep the innovation pipeline full of discoveries from fundamental science.

Mr. Martin made his speech, however, in the context of a continuing gap between productivity in the United States and Canada. Figure 11 shows labor productivity in Canada has stayed about 15 percent below the US level since 1980. In the manufacturing sector, the gap has generally been greater and has grown in recent years. Figure 12 shows the difference in income per capita in 1998, with the US level 25 percent above the Canadian level. The first figure focuses on output per hour worked, while the second shows national income divided by the total population. Thus, in translating productivity into the standard of living, the percentage of the population of working age, the labor force participation ratio, and the unemployment rate will all effect the standard of living for a given level of productivity. Sharpe (2001) brings these relationships out clearly. There is no cause for complacency in Canada, however, with regard to our relative performance in either productivity or standard of living compared with the United States.

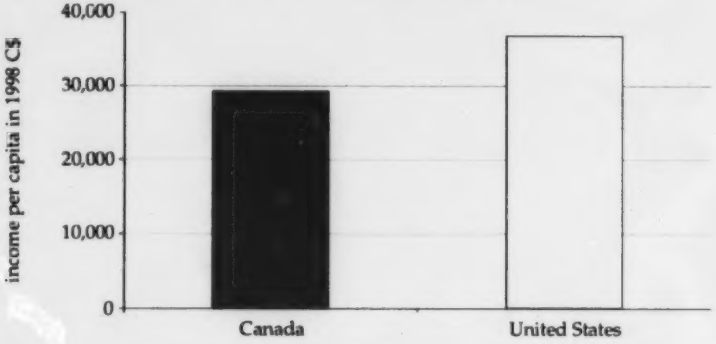
The significant public investments in university research have created a strangely bifurcated pattern of funding in Canada's major universities. Growing volumes of research funding contrast with a penury of operating funds. Programs begun since 1997 — including the Canada Foundation for Innovation, the Ontario Research

Figure 11: ***The Canadian-US Productivity Gap, 1980–98***



Source: Statistics Canada.

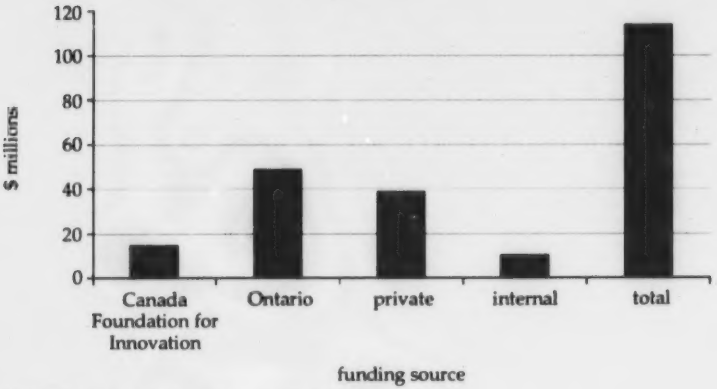
Figure 12: ***The Canadian-US Standard of Living Gap, 1998***



Note: US income per capita is converted at Purchasing Power Parity (C$1.00 = US$0.82).
Source: Statistics Canada.

and Development Challenge Fund, the Ontario Investment Trust, and associated private matching funds — have led to a remarkable increase in research funding, illustrated for the University of Western Ontario in Figure 13. Those who associate the regular announcements of new research funding at Western with general prosperity at the institution are often startled to hear that over the past decade faculty positions have fallen by 12 percent and staff by 16 percent, while enrollments have increased by 8 percent.

Figure 13: ***Research Funding at the University of Western Ontario from New Federal and Provincial Programs, fiscal years 1997/98 to 2000/01***



Note: Private includes other external funding.

Source: University of Western Ontario.

The reductions in real operating funds have forced Western to lay off staff and close faculty positions on a regular basis. Research funding, which is focused on equipment, laboratory renovations, and research assistants, generally does not allow for the payment of faculty salaries and indeed diverts operating funds away from teaching to the support of space and other infrastructure requirements of modern research. Hiring in Canadian universities over the past decade has generally been insufficient even to replace departing professors, at a time when we should be preparing for the enrollment boom of the coming years and anticipating the growing tightness of the faculty labor market.

Looking at the bifurcated approach to funding, one might think that Canada's national strategy for universities in the knowledge economy is to maintain a small nucleus of very well supported research professors in a limited number of fields and let the general education and research capacity of Canadian universities continue to decline. Such a strategy would fail, because the knowledge economy is broadly based — it is present "in all sectors," to use Mr. Martin's words — and is thus creating a growing demand for

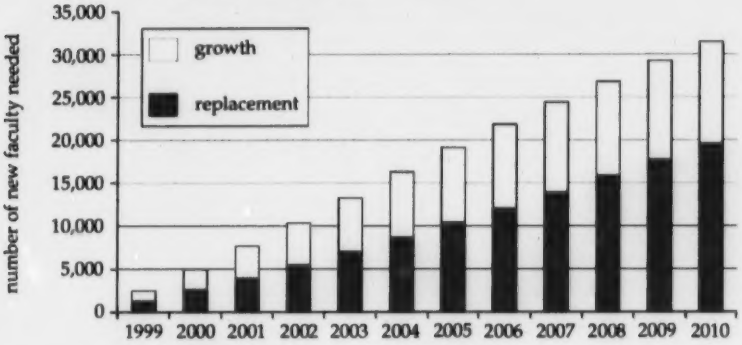
well-educated university graduates in all fields. Our current approach to university funding will not allow that broad demand to be met at a high quality of education, and will drive economic opportunities and talented people from Canada.

In this context, it may be helpful to use the distinction between *frontier knowledge* and *transferable knowledge* that Lloyd-Ellis and Roberts (2000) make. They conceive of frontier, or new, knowledge as knowledge produced in an innovation or research and development sector, in contrast to transferable knowledge, which is knowledge embodied in humans and transferred from one generation to the next by education. Sustained growth[6] requires both kinds of knowledge. Frontier knowledge alone will encounter diminishing returns without a complementary investment in education and transferable knowledge. The strategy of significant increases in research funding and reductions in real university operating funding per student employed over the past five years in Ontario and some other Canadian provinces can be viewed in these terms as a strategy that focuses on frontier knowledge alone. To get the full benefit of the investments in frontier knowledge, we need to invest also in the operating funds that support broad university education.

One way to think about the funding problem is in terms of faculty recruitment. Faculty retirements will be unusually high during the next decade, as the cohort hired for the first baby boom retires. To replace them and stabilize our current student-faculty ratio will require that we hire nearly as many new faculty over the next decade as we currently have in Canada (Figure 14). Put differently, annual levels of hiring over the next decade would have to be more than twice the average level of the 1990s (Figure 15). This will be difficult for three reasons. First, the United States will be experiencing the same combination of heavy faculty retirements and expanding student numbers. Second, PhD enrollments have not expanded in proportion to the need for new faculty in either country. Third, in many sectors the demand for PhDs outside the universities is expanding in response to the needs of the knowledge economy. Without very significant increases in university operating funds, we should expect the student-faculty ratio to continue rising.

6 In a constant elasticity of substitution production function.

Figure 14: ***Canadian University Faculty Hiring Requirements, 1999–2010***



Source: Association of Universities and Colleges of Canada.

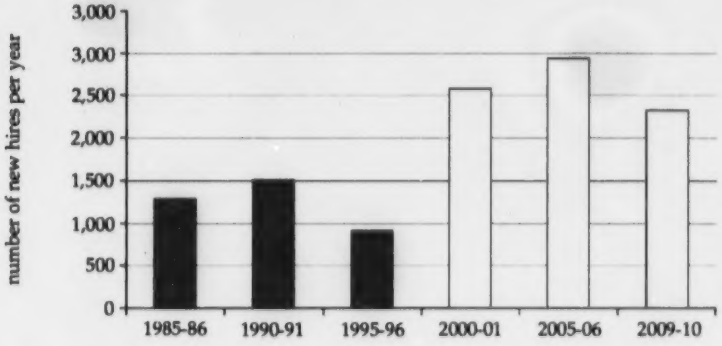
Meeting the Challenge of Accessibility and Quality

To meet the coming enrollment surge, we need to build on the investments in research of recent years with a similar substantial commitment to operating funds. The glass is half-full now. We need to fill it if we are to remain competitive in the North American knowledge economy. Fortunately, the challenges facing Canadian universities can be met if we focus on four policy initiatives: reducing the student-faculty ratio; funding the indirect costs of research; extending the growth in direct research funds; and building more income contingency into the repayment plans for student loans.

Reducing the Student-Faculty Ratio

A modest goal for the next ten years would be to reduce the average student-faculty ratio in Canadian universities by 10 percent, thereby narrowing the large gap with the United States. This will require sufficient increases in operating grants to achieve two objectives: to accommodate the surge in university enrollment while reducing the student-faculty ratio by 10 percent; and to ensure that Canadian faculty salaries do not become less competi-

Figure 15: ***Canadian University Faculty Annual Hiring Requirements, Selected Academic Years, 1985-86 to 2009-10***



Source: Association of Universities and Colleges of Canada.

tive with those in US public universities. The challenge will be a great one because, as noted above, the need for additional faculty will come at a time of record retirements.

In Ontario, for example, it is estimated that, over the next decade, universities will need to hire 13,500 new faculty — 7,500 to replace retirements and other departures, 4,200 to meet the enrollment expansion, and 1,800 to reduce the student-faculty ratio by 10 percent (Council of Ontario Universities 2000). This total is greater than the current level of 12,000 full-time faculty. By the 2005–06 academic year, additional provincial operating funding of some $600 million a year will be needed, along with the additional tuition revenue from higher enrollment, to enable all Ontario universities to accommodate most students and reduce the student-faculty ratio by 10 percent.[7] Without such a commitment of public

7 See Council of Ontario Universities (2000, 15). My total consists of the $456 million shown in that document and an additional $144 million to recruit 1,800 additional faculty to bring down the student-faculty ratio. In its spring 2000 budget, Ontario announced that tuition fees in regulated programs would be limited to increases of 2 percent per year for the next five years, a decision that underscores the need for public funds to meet the accessibility challenge. In its spring 2001 budget, the province committed funding of...

funds, we will not maintain an affordable university system of high quality. Graduate programs in Canada have not been expanding at a rate sufficient to meet this challenge, and we can expect severe competition, both in hiring and in salary levels, from the United States (Smith 2000).

Funding the Indirect Costs of Research

For years, Canada's universities have called on the federal government to fund the indirect costs of the research on its direct research grants. These indirect costs are costs assumed by the university, not by the individual research grant holder, in such areas as the capital and operating costs of space, information technology, library, and accounting. In its spring 2000 budget, the Ontario government announced such funding for its own research grants. The generally accepted rate of indirect cost, and the one adopted by Ontario, is 40 percent of the direct grants. Provision of these funds by the federal government would help in building world-class centers of research excellence, by allowing universities to use the funding of indirect costs to build on their strengths.

In its December 2001 budget, the federal government announced funding for the indirect costs of research on federal grants for one year at a rate of about 20 percent, and signaled its intention to consider funding the indirect costs on a permanent basis. This breakthrough on the issue was immediately celebrated by Canada's research community. It is to be hoped that future federal budgets will raise the indirect cost rate to 40 percent and make the policy permanent. Provision of the indirect costs of research would help Canadian universities build on their strengths and create world-class centers of excellence. The funds would be allocated among universities on the basis of peer-reviewed grant competition, thereby fostering competitive excellence and providing an incentive to institutions to make difficult selective choices in support of outstanding research.

Note 7 - cont'd.

...$220 million for expanding university enrollments to 2003–04. This can be seen as a first payment on the $600 million suggested here.

Extending the Growth of Direct Research Funds

While direct support for research in Canadian universities has grown significantly over the past five years, the average size of grants, measured per faculty and the percentage of faculty receiving grants, is still only a fraction of that in the United States. We need to continue the upward trend and extend new funding to the social sciences and humanities. New government research funding programs have for the most part focused on science, engineering, and medicine. It is now time to expand the opportunities for outstanding faculty in the social sciences and humanities, whose work is vital to the guidance of private decisions and public policy in such areas as economic regulation, immigration, bioethics, and support of Canadian culture.[8]

Building an Income-Contingent Loan Repayment System

Maintaining accessibility requires not only that the faculty and staff are in place to teach and serve students, but that the resulting education is affordable. Rising tuition over the past decade has led to growing debt loads for students. While default rates have declined slightly in Ontario in recent years (look back at Figure 9), there is nonetheless a growing concern among students and parents with regard to student debt and potential default. During the later 1990s, the federal and Ontario governments increased support for student aid significantly, with programs for interest relief, interest deductibility, and new scholarships, as loans outstanding increased steadily. There is, in my view, one very desirable policy that has been discussed at some length but that has yet to be implemented: a full-fledged income-contingent loan repayment plan coordinated between the two levels of government, involving both interest relief and debt reduction.

8 On the importance of university research in the humanities and social sciences, see Davenport (2000).

Such a comprehensive plan would involve society sharing the risk involved in student borrowing, and providing sufficient help to those with very limited incomes to keep them from defaulting. This would increase accessibility, especially for students from low-income families who might hesitate to take out a student loan because of the potential for default. Such a plan would also be beneficial to society as a whole, as it reaps the productivity and tax benefits of the majority of university graduates who are very successful on the labor market, at the relatively minor cost of helping those who are not.

While the knowledge economy, with globalization and rapid technological change, is opening up tremendous opportunities for Canadians, we must make the necessary public investments to prepare our workforce to compete in that economy. Although Canada lags behind the United States in the percentage of the labor force with a university degree, it is ahead of major European countries. Canada has thus been doing a fairly good job in encouraging university participation, but that accessibility has been bought at an unacceptable rate of increase in the student-faculty ratio. As we look ahead to the echo of the baby boom, we need a commitment to increase public funding in a manner that will accommodate large numbers of additional students while reducing the student-faculty ratio. With sufficient public funding for operating budgets and student aid, complemented by private giving and tuition, we can increase the quality of our universities and keep them affordable.

References

Abramovitz, Moses, and Paul David. 1996. "Technological Change and the Rise of Intangible Investments: The US Economy's Growth-Path in the Twentieth Century." In D. Foray and B.A. Lundvall, eds., *Employment and Growth in the Knowledge-Based Economy*. Paris: Organisation for Economic Co-operation and Development.

Allen, Robert G. 1998. "The Employability of University Graduates in the Humanities, Social Sciences, and Education: Recent Statistical Evidence." Ottawa: Social Sciences and Humanities Research Council of Canada. August. Mimeo.

Ashenfelter, Orley, and Alan Krueger. 1994. "Estimates of the Economic Return to Schooling from a New Sample of Twins." *American Economic Review* 84 (December): 1157–1173.

Ball, Philip. 1997. *Made to Measure: New Materials for the 21st Century*. Princeton, NJ: Princeton University Press.

Council of Ontario Universities. 2000. *Access to Excellence*. Toronto: COU.

Davenport, Paul. 1997. "Le paradoxe de la productivité et la gestion des technologies de l'information." In M.C. Monnoyer, ed., *L'entreprise et l'outil informationnel*. Paris: L'Harmattan.

———. 1998. "The Productivity Paradox and the Management of Information Technology." *Europe Productivity Ideas* 3: 1–3.

———. 2000. "The Liberal Arts in the Knowledge Society." University of Toronto Convocation Address. Available from Internet website: www.uwo.ca/pvp/honors/faculty/hondegrees/pres1.htm.

Drucker, Peter F. 1993. *Post-Capitalist Society*. New York: HarperCollins.

Francis, Diane. 1998. "Universities grabbing too big a slice of the education pie." *Financial Post*. September 22.

Lloyd-Ellis, Huw, and Joanne Roberts. 2000. "Twin Engines of Growth." Canadian Institute for Advanced Research, Program in Economic Growth and Policy Working Paper 143. Toronto.

Machlup, F. 1962. *The Production and Distribution of Knowledge in the United States*. Princeton, NJ: Princeton University Press.

Martin, Paul. 2001. "Winning the World Over." Available from Internet website: www.fin.gc.ca.

Riddell, W. Craig, and Arthur Sweetman. 2000. "Human Capital Formation in a Period of Rapid Change." In W. Craig Riddell and France St-Hilaire, eds., *Adapting Public Policy to a Labour Market in Transition*. Montreal: Institute for Research on Public Policy.

Senge, P. 1990. *The Fifth Discipline: The Art and Practice of Learning*. New York: Doubleday.

Sharpe, Andrew. 2001. "Determinants of Trends in Living Standards in Canada and the United States, 1989–2000." *International Productivity Monitor* 2 (Spring): 3–10.

Smith, David C. 2000. "Will There Be Enough Excellent Profs? Report on Prospective Demand and Supply Conditions for University Faculty in Ontario." Toronto: Council of Ontario Universities.

Thackray, Arnold, ed. 1997. *Private Science: Biotechnology and the Rise of the Molecular Sciences*. Philadelphia: University of Pennsylvania Press.

Do We Have a Problem Yet?
Women and Men in Higher Education

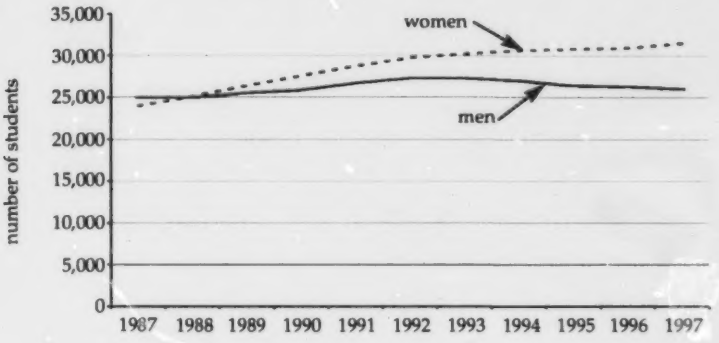
Stephen T. Easton

The last decade of the twentieth century saw a profound change in the enrollment structure of Canadian higher education. From 1987 to 1997, total university enrollment increased from 486,009 to 573,099. At the same time, the ratio of women to men on campus increased from rough parity in 1987 to 1.2 women for every man in 1997. This shift may be a boon for the men that have arrived, but the disparity is as much a cause for concern today as it was when the numbers were reversed — long ago in 1979.

Should we care? If this disparity in enrollment rates simply reflects a difference in the tastes of young people of the two sexes, then we might say, *laissez-faire*. But if it is a result of policy, we may want to redress the balance. There is little reason to believe that a Canadian university education should be directed primarily at either men or women. The parents of both are taxed at the same rates to pay for it. Both pay the same fees. Clearly, both should have equal opportunity for access. Do Canadians benefit from having one sex less well educated than another? Nobody wants to see an underclass of undereducated men or women. Higher education may not be for all, but a child's sex is not, obviously, the way to make the decision about schooling. Most educators and education specialists in this day and age presume that a rough equality should be present among our most well-educated citizens.[1] Yet no such equality exists in Canada today and the gap appears to be growing.

1 As long as women have a primary role in child production and early child-raising there will always be an incentive to have different educational levels...

Figure 1: ***Full-Time University Enrollment by Sex, Canada, 1987–97***



Source: Statistics Canada, CANSIM database.

Do we have a problem yet? If so, why? Any statement about the reasons for the relative increase in university enrollments by Canadian women is bound to be speculative. Nonetheless, looking at the most simple measures may prove useful — albeit brave.

Figure 1 shows the number of full-time students enrolled in Canadian universities from 1987 to 1997. The divergence between the rates of attendance for men and women is immediately striking.

A Clear Pattern

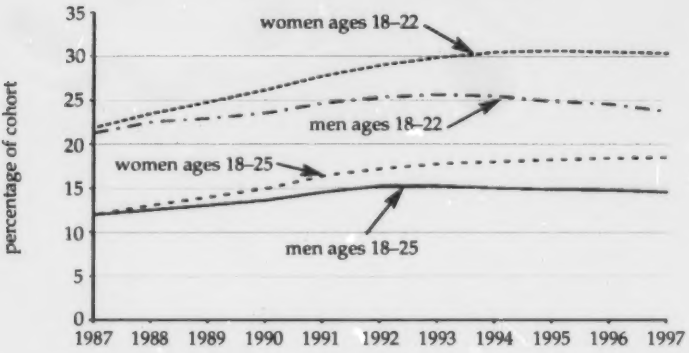
The total number of Canadians likely to seek higher education in any given year may be driven by demographic factors, but there is nothing in the demography to explain the increasingly unequal attendance rates. If there were more women than men for a particular age group, then we would find more women than men to be

---

Note 1 - cont'd.

...than men. On the one hand, with a potentially shorter market labor force experience, women will tend to have less time to recoup any investment in education. On the other hand, they will want to substitute education for experience as a way to raise lifetime income. Although these competing forces suggest that equality of education between men and women is not implied by basic theory, since they tend to offset, differences in desired average education levels are likely to be small.

Figure 2: ***Full-Time University Enrollment by Sex, Relative to Age Cohorts, Canada, 1987–97***



Sources: Statistics Canada, CANSIM database; and data from Figure 1.

in school even if their attendance rates were identical. But a look at the relevant age-sex cohorts belies this possible explanation.

Figure 2 plots the number of men and women in university relative to the number of men and women at specific ages in the general population. We assume that those ages 18 to 22 are most likely to attend university; the top two lines in the figure report the shares of women and men of that cohort attending university full time. Notice that since 1993 the line representing the share of university-going men in that age group has declined. Women in the corresponding age cohort increased their proportion of university-goers from 1993 to 1997; that rate has stabilized in the past four years.

The second pair of lines shows that the same pattern persists in the larger 18-to-25-year-old cohort, providing additional evidence that the decline in the number of university men relative to university women is not some short-term blip, but a definite pattern.

Table 1 describes the relative numbers of men and women enrolled as undergraduates in university for the most recent decade for which data are available from Statistics Canada.[2] The second column presents total enrollment in Canadian universities and the

2 A quick perusal of provincial government education websites will confirm that the trends are not changing.

Table 1: ***Ratio of Women to Men in Full-Time University Enrollment, Canada, 1987–97***

	Total Enrollment	Ratio of Women to Men
1987	486,009	0.97
1988	499,520	0.99
1989	515,025	1.03
1990	532,131	1.05
1991	553,954	1.07
1992	569,480	1.09
1993	574,320	1.11
1994	575,713	1.13
1995	573,194	1.16
1996	573,635	1.17
1997	573,099	1.20

Source: Statistics Canada, CANSIM database.

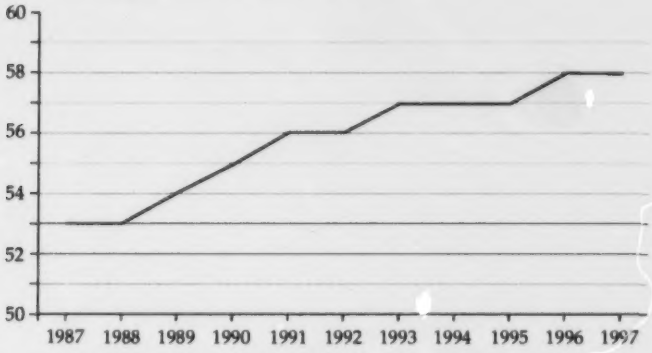
third indicates the ratio of women to men in university. In the 11 years included in the table, the fraction of students who were women has risen steadily. The patterns in Table 1 show that the growth in the number of students has been steady throughout the early 1990s. There is no reason to believe that the changing ratio of women to men is due to rapidly fluctuating total enrollments. There are currently more than 1.2 women per man in universities across the country.

The same trend is present in the ratio of women to men receiving university degrees, as shown in Figure 3. Women have tended to receive more degrees for the past decade, not surprisingly given the numbers in Table 1; their share of total degrees granted is increasing as well.

A National Trend

The remarkable thing about the numbers presented in Table 1, which are national averages, is how faithfully they are reflected at

Figure 3: ***Percentage of All Degrees Granted Going to Women, Canada, 1987–97***



Source: Statistics Canada, CANSIM database.

the provincial level. Each of the provinces shows the ratio of women to men attending university growing, albeit at differing rates. Table 2 lays it out with the first and last years highlighted to emphasize the significance of the growth in each of the provinces over the whole period. The average increase in the provincial ratios of women to men is about 2.3 percentage points per year. This is consistent with the national trend of higher university women to men ratios.

History Reversed

Historically, these ratios have been weighted toward men. In 1939 about 13 percent of Canadian university graduates were women — a ratio of 0.15 women per man. In 1946 the figure was 22 percent, or a ratio of 0.28 women per man. By 1960/61, the ratio had grown to 0.35, and by 1970 it reached 0.62 women per man. The sexes reached equality in terms of first university degrees in the early 1980s.

Where Have the Boys Gone?

If fewer young men, proportionally, are attending university full time, what are they doing instead? Are more males deciding to go to university on a part-time basis? Are they choosing college over

Table 2: ***Ratio of Women to Men in Full-Time University Enrollment, by Province, 1987–97***

	Newfound-land	P.E.I.	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Sask-atchewan	Alberta	British Columbia
1987	**1.13**	**1.18**	**1.03**	**0.97**	**0.99**	**0.97**	**0.91**	**0.94**	**0.94**	**0.88**
1988	1.17	1.24	1.10	1.01	0.99	1.00	0.96	0.94	0.97	0.93
1989	1.18	1.25	1.14	1.06	1.04	1.03	0.99	0.98	1.00	0.96
1990	1.20	1.22	1.15	1.09	1.06	1.05	1.00	1.02	1.03	1.00
1991	1.19	1.22	1.16	1.12	1.08	1.06	1.02	1.06	1.07	1.01
1992	1.24	1.21	1.15	1.12	1.10	1.07	1.03	1.08	1.09	1.05
1993	1.23	1.32	1.17	1.14	1.12	1.09	1.05	1.11	1.12	1.08
1994	1.24	1.45	1.22	1.13	1.16	1.10	1.08	1.12	1.15	1.10
1995	1.28	1.56	1.25	1.19	1.19	1.13	1.12	1.16	1.16	1.14
1996	1.27	1.58	1.25	1.19	1.20	1.15	1.18	1.21	1.16	1.12
1997	**1.31**	**1.59**	**1.28**	**1.21**	**1.22**	**1.17**	**1.19**	**1.26**	**1.17**	**1.18**

Source: Statistics Canada, CANSIM database.

university? Or are they simply not opting for higher education as often as women?

Part-Time Enrollment

The possibility that more men are turning from full-time to part-time university turns out not to be the case. While the number of part-time students in Canadian universities is decreasing, there is only the slightest tendency for part-time studies to be frequented increasingly by men. From 1987 to 1997 the ratio of women to men in part time university studies fell from 1.6 women per man to 1.55 women per man. The number of students taking their university education part time fell from 300,000 to 250,000, or about 15 percent. This is particularly interesting because the number of full-time university students actually *increased* from 480,000 to 570,000 (or about 18 percent) during the same period. It would be unreasonable, therefore, to believe that men are substituting part-time for full-time higher education.

The College Alternative

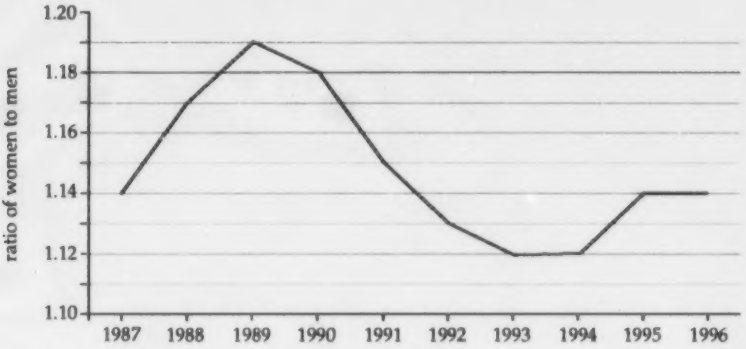
If men are not moving to part-time studies, are they turning more frequently to colleges? Here, too, the answer appears to be no. As Figure 4 shows, at the usual 5 percent confidence level, there is no tendency for the fraction of men enrolling in Canadian colleges to increase. Over the past decade, the share of men in the college system has increased not a whit, although that observation masks a series of statistically insignificant fluctuations about this level.

There is no evidence of a significant shift from university to college among young men, and certainly not relative to the number of women. If men are increasingly substituting college for university, the change is a modest one.

An Economist's View

It seems, therefore, that young men are not switching to part-time studies, or to college, in droves; why then are they enrolling in university in smaller proportions than their female peers? I cannot

Figure 4: ***Ratio of Women to Men in Colleges, Canada, 1987–96***



Source: Statistics Canada, CANSIM database.

give a definitive answer, but I can offer some insight into the issue from the economist's traditional two boxes of supply and demand. Let us examine each in turn.[3]

Demand: The Rate of Return on a Degree

First, let us think of what could be termed the demand side of the framework: the rate of return to a university education — that is,

3 I have committed a slight abuse of the nomenclature of demand and supply — call it poetic license. Usually we think of the university as *supplying* an education and students *demanding* it. My argument assumes that students *demand* an education as directed by incentives. The issue of who goes to university from high school is more complex, of course. Although students may demand university preparation in their high-school courses, the process that prepares them — supplies the education to students who wish to go to university — involves more than a simple choice by students. If we were to insist on a precise characterization of supply and demand, I would claim that the student *demands* the university education in the usual way, but that the *opportunity* to go to university is supplied by the secondary school. Shocks that hit the high-schooling process are different from demand-related shocks facing the student arising from the opportunities to use a university education. Of course, in all of this I am ignoring the traditional "supply" of university places and how they are determined. But these must be secondary in looking at the relative numbers of male and female students.

the amount by which someone can expect his or her income to rise as a result of having a degree, relative to the cost of obtaining the degree. Has this rate changed for men, women, or both? Does it pay relatively better for women to receive higher education today than it did in the past? Or is the return on higher education falling for young men?

Either way, the key is the return expected relative to the next best alternative — presumably a high school diploma, a trade, and/or a college certificate, for the most part. In our approach, the individual student makes demands on the university system guided by the rate of return each expects.

The Available Data

To investigate this incentive-based explanation, we need to know what has happened to the rates of return on university education for men and women. Ideally, we would have measures of the expected rates of return on university education facing students of each sex for each year as they prepared to enter. Even more than that, in an ideal world, or at least in a data-rich world, we would have the rates of return that students could anticipate for *all* types of education. Given their talents and resources and interests, students would choose the kind of education that maximized their individual rates of return. We do not, however, live in this data-rich environment. There are relatively few estimates of the returns to university education in Canada. Fewer still are broken down by sex, and none reports those returns as a time series over the past century.

Even without formal rates of return, however, we can still find some information about the potential rewards to a university degree. Recent work by Statistics Canada (1999), for example, calculates the ratio of earnings between men and women by (some measures of) education level since 1971, and with consistent data shows that, in the past decade, the ratio of women's to men's income rose by 10 percent. Figure 5 illustrates the average earnings of full-time male and female employees as well as their ratio. The topmost line is the ratio of women's to men's income.

Figure 5: ***Earnings of Men and Women in Full-Time Employment, Canada, 1967–97***

Source: Statistics Canada 1999, table 1.

Although more awkwardly linked, data by education level are also available.[4] But this point raises a question as to exactly what approach to forecasting is appropriate for a student of today looking to the future to gauge returns (and, of course, anticipating the costs of education and the like).[5] I do not have a very good answer to this question. My strategy, however, is to take the most simple framework and see if there is any merit in what would surely be one variable that is related to the decision process, however imperfectly. To these ends, we need a calculation of the wages of men and women associated with a university degree and those associated with finishing high school. I focus on these two groups because the evidence from the past few decades suggests relatively little substitution into college or part-time university studies.

Recent work by Beaudry and Green (1997) gives us a framework to impute the wage rates to different groups, ignoring short-

4 Some of the education levels are not entirely consistent over the period.

5 There are many ways to forecast the future! We could assume that we have perfect foresight, we could assume that we are correct in our forecasts on average, or we could assume that the future looks exactly like the past. These are a few of the possible forecasts.

run phenomena such as unemployment. In their study, they construct a model of the earnings of men and women who have university as their highest level of education, and of those whose highest level of education is high school. Their model draws data from Statistics Canada's Survey of Consumer Finances from 1971 to 1993.[6]

Changes in the financial reward offered by more education are expected to guide the amount of education a person demands. An ideal construction would separate changes in the observed return that result from additional people obtaining an education, which would tend to drive the average return down, from shifts in the return that result from changes in technology or other factors. This approach, however, would entail a great deal of confidence in the underlying model of production. As an alternative to discovering the time shifts in the marginal product of education function, what I have done is to use the model of returns to education for men and women estimated by Beaudry and Green to impute a wage to education based solely on men's or women's experience, proxied by their age (and age squared), the cohort in which they were born, and some interactions.

The details of the formula are displayed in Table 3; the dependent variable is the log of earnings (adjusted for inflation). I have not included what I take to be short-run variables, such as the rate of unemployment.

Figure 6 displays a plot of the pattern of earnings associated with the different levels of education. The data are in logs and should be thought of as indexes. They are internally consistent, but not benchmarked to wages, since short-term variables such as the unemployment rate are left out.

The high degree of correlation inherent in the construction of the measures of wages to each of the four groups, and the tendency for enrollments to follow a rolling average of entrances, ensures a complex time series structure. The smoothness of the income indexes as forecasts of the gross return to different levels of educa-

6 Several other recent studies also produce returns to men's and womens' education, but they are not as easily adapted to our purposes. See, for example, Drolet 2001; and Baker and Fortin 2000. Beaudry and Green (1997) also list many of the recent studies.

Table 3: ***Estimating Equations for Earnings of Males and Females with High School or University Education, Canada, 1971–96***

	High School Education		University Education	
	Males	**Females**	**Males**	**Females**
Intercept	5.81	5.33	6.18	5.95
Cohort	0.04	0.032	-0.012	-0.024
Cohort^2	-0.0028	-0.0019	-0.0001	0.0008
Cohort*age	-0.0021	-0.0008	-0.0004	0.0021
Age	0.04	0.01	0.065	0.004
Age^2	-0.0015	-0.00008	-0.0027	0.00009
Age^3	0.00002	-0.000002	0.00003	-0.000005

Source: Beaudry and Green 1997, tables 1–4.

tion is probably appropriate as forecasts of future values are likely to be weighted averages of anticipated future values.

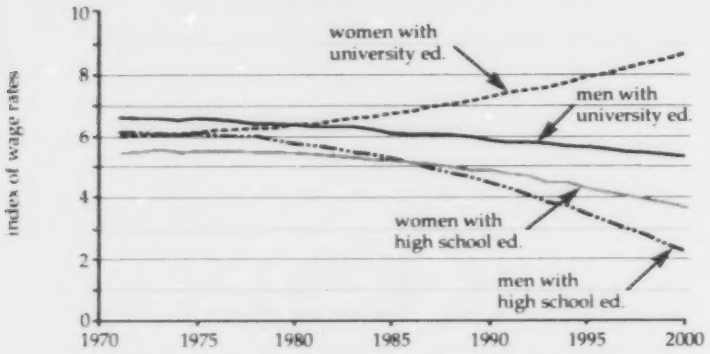
From the figure, it is apparent that the income received by full-time female university graduates is increasing but declining modestly for men. (The income return from a high school education is falling for both men and women, with men's income falling faster in this category.)

The Responsiveness of Enrollment to Wage Changes

The simplest approach to measuring how responsive enrollment levels are to changes in wages — the heart of the "demand" explanation — is to regress the relative number of female university students (the female-to-male ratio) on their opportunity costs and the relative number of female and male students who are enrolled in grades 12 and 13.

Table 4 shows the results of this regression. The dependent variable is (the log of) the ratio of female to male undergraduates. The relevant opportunity cost measures are the difference between

Figure 6: ***Indexes of Wages for Men and Women with University and High School Education, Canada, 1971–2000***



Source: Author's calculations from the data in Table 3.

the (log of the) wages received by university women, UW, the wages received by women with high school as their highest level of education, HSW, and the same difference for men, UM-HSM.

In addition, the lagged value of high school graduates, identified in the table as the (log of the) ratio GRADEF(-1)/GRADEM(-1), is potentially relevant. High school graduates constitute, at least nominally, the largest readily identifiable pool eligible for entry to university.[7] The ratio is lagged, since the entering class this year depends most directly on the number of high school graduates from the previous year. Unfortunately, high school graduates are not reported by sex, so we have had to use the actual numbers of male and female students in grades 12 and 13 as indicators of potential readiness for university.[8] In the table, the variable QM is

7 The problem is more complex, since in reality not all students who go to university do so immediately after high school. It would be desirable to distinguish those who enter university from each high school each year, but what we have are all students in the upper grades and the total enrollment of the universities. At some point, we could refine the measure to include only first-year students, but students who transfer from colleges and life-long learners will always make this a more complex issue with a range of opportunity costs not easily characterized.

8 From 1975, one has to distinguish between CEGEP and high school in Quebec.

Table 4: *Ratio of Female to Male Undergraduates, 1972–94*

(as measured by the dependent variable LOG((UGFCAN)/UGMCAN)

Variable	Coefficient	t-Statistic	Coefficient	t-Statistic
C	–0.35	–15.6	**–0.28**	**–5.97**
UW-HSW	0.76	10.2	**0.69**	**2.48**
UM-HSM	–1.01	–7.7	**–0.92**	**–2.02**
LOG(GRADEF(–1)/ GRADEM(–1))	0.79	2.5	**0.19**	**0.66**
QM	1.36E-06	3.73	**3.14E-07**	**0.94**
AR(1)			**0.76**	**5.84**
R-squared	0.99	**R-squared**		**0.996**
Adjusted R-squared	0.99	**Adjusted R-squared**		**0.995**
Standard error of regression	0.016	**Standard error of regression**		**0.013**
Durbin-Watson statistic	1.74	**Durbin-Watson statistic**		**2.04**

Note: Shaded figures are corrected for autocorrelation.

Sources: Wage data from Figure 6; grade 12 data for 1972–75 from Statistics Canada 1978; for 1976–79, from Statistics Canada 1979; for 1980–94, from Statistics Canada, cat 81-229, various issues.

a (0,1) dummy that identifies Quebec's move away from grade 12 and 13 to a format of grade 11 graduation followed by CEGEP. It has little role to play in our analysis as its coefficient is very small.

There are two regressions reported in the table. The first is written without shading and the second is shaded. Both report a regression for the same set of variables; the only difference between the two is a correction for autocorrelation. Fortunately, little of substance changes.[9]

The most interesting result is the magnitude and the sign of relative incomes. I will confine my remarks to the first two columns

9 Autocorrelation in the residuals tends to make results appear to be more statistically significant than they really are. The correction ensures that the levels of statistical significance are appropriate. I present both uncorrected and corrected data, as is common practice, to show that the coefficients are consistent.

for the moment and comment on the difference between the simple regression and the corrected one below.

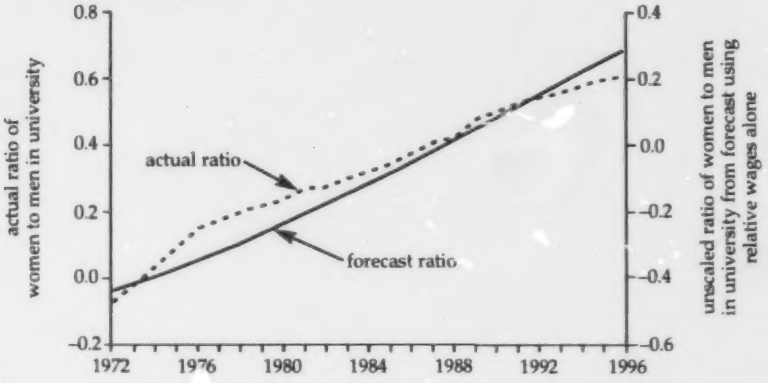
I begin by baldly interpreting the coefficients in the table. In the first column of coefficients, the impact of an increase in the relative return to university education over high school is positive. That is, more women will tend to be in university when the relative wage received by women with higher education increases. Recall that the measures are of the difference between the (log of the) wage that is received by a university graduate and that received by a high school graduate. The coefficient is positive and statistically significantly different from zero at the usual 5 percent confidence level.

Further, a 10 percent increase in the relative wage received by female university graduates over their high-school-educated counterparts induces a 7.6 percent increase in the male-to-female ratio of undergraduates. Although we have little theory to guide us, it is interesting (and possibly suspicious) that the result appears so prompt and so strong.

A similar finding is also relevant for men. In this case, the result is effectively proportional. That is, a 10 percent increase in the relative wage rate of university men leads to a 10 percent fall in the ratio of women to men in university. This is interesting insofar as the coefficient is statistically different from zero, but the proportional response is not particularly revealing, as one does not have strong prior beliefs about what the appropriate magnitude of the coefficient should be.

There is a difference between the coefficients associated with the two sexes. That is, statistically, the response of men to changes in the wage of the university-educated relative to the wage of the high-school-educated differs from the response of women. Men appear to respond more elastically to the reward changes than do women. If this finding is confirmed — and recall the many caveats along the way in this study — it would be an interesting result. Usually, in labor supply studies, women tend to be the higher-elasticity participants. That is rationalized by their more complex labor market behavior — balancing childbearing and family with labor force participation. However, these data suggest the opposite — that men have the higher elasticity of response to wage incentives.

Figure 7: ***Predictions by Relative Wage Rate Changes Alone, Canada, 1972–96***



The different rate of response by men and women (to the income differentials) gives the correct magnitude of changes in the proportions of university students. This tells us that both play a role in determining changes in the ratio of men and women in university. Although there are any number of ways to display the information, if one plots the impact of the wage rate differential changes multiplied by their coefficients, one can superimpose the net effect on the actual growth rate of the ratio of men to women in university. This is done in Figure 7.

Although there is clearly much left to explain in the pattern of enrollments by men and women, the relative wage story is at least one credible component, since it picks up some of the changes.

Supply: The Number of University-Ready Students

The flip side of the possible explanation focuses on what I would like to call the "supply" of students: the university readiness of students coming from high school. If women are better prepared than men by high schools, and if universities are sex-blind and do not admit men differentially, then women will tend to be accepted in relatively greater proportion. This aspect of the problem is even less well studied, but I think it worth investigating

What factors in the educational process that takes place before university — at high school and even earlier — might prepare boys and girls in increasingly different proportions for university-level work? One likely candidate is the proportion of assessment that is based on classroom work versus that based on province-wide exams.

In British Columbia, for example, as Peter Cowley and I report (1999), while boys may, on average, do better or worse than girls on the province-wide final exams depending on the subject, they always received poorer marks on average than girls in their school-based assessment. Since school-based assessment provides 60 percent of the final grade in provincially examinable grade 12 classes, it has the potential to have a significant impact on the ability of different students to graduate or otherwise qualify for university.[10]

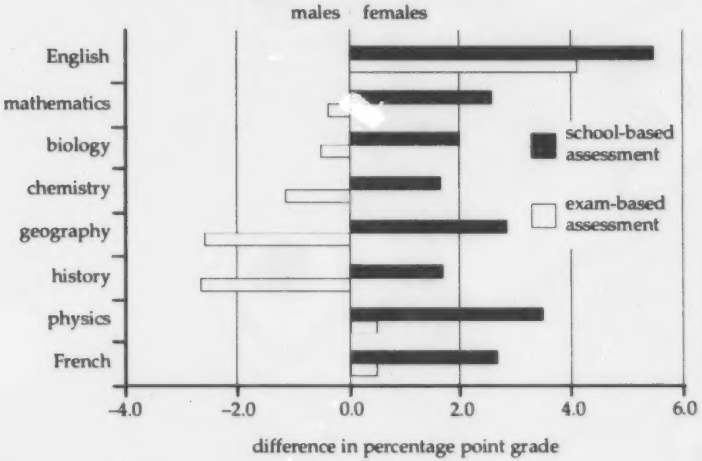
Figure 8 illustrates the class-based and exam-based assessments for British Columbia's 1996/97 marks. For each of the most popular subjects in the province, the figure displays the average differential in marks received by boys and girls in their school-based assessment (the dark bar) and their exam-based assessment (the light bar). The subjects are arrayed in the order of the frequency with which they were taken.

For example, in English (the most frequently written exam), girls perform better than boys on both their school-based assessment (by nearly 6 percentage points) and their provincial exam results (4 percentage points better). In math, girls' school-based assessment is 2 percentage points better, although their exam-based results are marginally poorer. The same pattern is true in biology, and chemistry, and is most dramatic in geography and history. Women have better school assessment and exam scores in physics and French.

As suggested above, what stands out from the figure is the tendency for girls always to receive higher marks in the school-based assessment. Such a picture raises a host of questions. If university

10 Recall that hundreds of thousands of students take exams. Although I do not do the arithmetic to calculate how the number of boys versus girls would change with a different weighting of the school and exam marks, the reader will appreciate that there are many students who are marginal and for whom small differences in the total grade mean "go" or "no go."

Figure 8: ***School-Based versus Exam-Based Assessments by High School Course, British Columbia, 1996/97 School Year***



Source: Cowley and Easton 1999, figure 2.

eligibility was historically more heavily exam weighted than school-assessment weighted, then our increasingly school-based assessment process may provide some explanation for a growing pool of female university-eligible high school graduates.

Are these patterns mirrored in other provinces? Since I am not aware of other studies that track Canadian school-based versus exam-based performance, and ours deals exclusively with British Columbia, such a supply-based approach will have to wait until appropriate data are available to assess the usefulness of the hypothesis.

It may not be the case that everything we learn is learned in kindergarten, but it is surely the case that the sex disparity phenomenon that is overtaking the universities is a process that started long before. We need to assess why boys are relatively less successful than girls in the classroom, regardless of how well their external exam scores suggest they know the material. Is it exclusively a matter of weighting? Or are boys performing less well because of something that is being done differently, either at home or at school?

Conclusion

We do not know why university enrollment proportions are changing so dramatically. Perhaps men simply make more money in computer technologies and sports, for which university education is less of a prerequisite. I have looked at the issues from the economist's traditional two points of view, demand and supply, and have argued that there are reasons to believe that both have some ability to explain the phenomenon. Although the evidence is far from conclusive, the increase in the average woman's wage relative to the cost of her university education may explain some of the demand side of the story, since the actual income received by university men appears to be falling gradually.

On the supply side of the ledger, the importance of young women going to university has been emphasized for years. Institutionally, increasing weight has been placed on areas of secondary school performance in which women are relatively more successful (Cowley and Easton, 1999). There is, however, no quantitative assessment of the consequences of these changes.

Is the sex-related change in university enrollment a good thing? That is a debate worth having. In the meantime, the reasons behind the change should continue to be investigated. It would be unfortunate if, in a world in which we expect jobs to increasingly emphasize the accumulation of knowledge, we did not understand why it is that fewer men are turning to university.

References

Baker, Michael, and Nicole Fortin. 2000. "The Gender Composition and Wages: Why Is Canada Different from the United States?" Analytical Studies Branch research paper. Cat. 11F0019MPE140. Ottawa: Statistics Canada.

Beaudry, Paul, and David Green. 1997. "Cohort Patterns in Canadian Earnings: Assessing the Role of Skill Premia in Inequality Trends." NBER Working Paper 6132. Cambridge, Mass.: National Bureau of Economic Research.

Cowley, Peter, and Stephen Easton. 1999. "Boys, Girls, and Grades: Academic Gender Balance in British Columbia's Secondary Schools." *Public Policy Sources* 26. Vancouver: Fraser Institute.

Drolet, Marie. 2001 "The Persistent Gap: New Evidence on the Canadian Gender Wage Gap." Analytical Studies Branch research paper. Cat. 11F0019MPE157. Ottawa: Statistics Canada.

Statistics Canada. 1978. *Historical Compendium of Education Statistics: From Confederation to 1975*. Cat. 81-568. Ottawa.

– ——. 1979. *Education Statistics for the Seventies*. Cat. 81-569. Ottawa.

———. 1999. Consumer Income and Expenditure Division. *Earnings of Men and Women*. Cat. 13-217-XIB. Ottawa. June.

———. *Advanced Statistics of Education*. Cat. 81-220. Various issues. Ottawa.

———. *Education in Canada*. Cat. 81-229. Various issues. Ottawa.

———, and the Canadian Education Statistics Council. 2000. *Education Indicators in Canada: Report of the Pan-Canadian Education Indicators Program 1999*. Cat. 81-582-XPE. Ottawa.

The Global Talent Hunt and the Growth of e-Recruiting in Canada

Alice Nakamura and Joel Bruneau

Thomas Courchene states that economic policy should strive toward "developing, enhancing and employing-in-Canada the human capital of Canadians" (2001, 12). Canadian universities are committed to developing and enhancing Canadian human capital, but who is responsible for attending to Courchene's third point of employing the human capital of Canadians in this country? Success in that area must go hand in hand with the first two items to benefit Canada as a whole, and the importance of retaining educated human capital (Courchene's third item) will grow in importance.

An educated workforce is the critical resource for success in the new knowledge-based economy. The traditionally high quality of Canadian universities has made Canadian university-trained talent attractive to US and other foreign recruiters. The increased use of the Internet for recruiting — e-recruiting — poses a selective brain drain threat to Canada, and the problem is becoming more

The authors thank economists Mel McMillan, Emi Nakamura, and especially David Laidler, as well as Ken Nakamura, a medical doctor, for helpful comments on this and an original version of the paper titled "Post-Secondary Funding, Admissions and Job Placement." The original version was presented on June 2, 2001, in Montreal at the C.D. Howe Institute session, "Universities and the Canadian Economy," at the 35th Annual Meetings of the Canadian Economics Association. The authors bear sole responsibility for any errors of fact or interpretation.

serious due to Canadian progress in getting students on-line, coupled with the growth of e-recruiting. US dominance in the industry gives the largest recruiters, which are often US-based, the advantage in recruiting Canadian talent.[1] The human capital that Canada produces and then loses to foreign competitors may, quite literally, work against the future prosperity of this country, though Canada does, of course, gain workers educated in other countries as well.[2]

In this paper, we first describe e-recruiting and then examine three of the leading commercial e-recruiting services operating in Canada. We discuss their business operations and look at the many ways they earn profits. We next introduce two nonprofit e-recruiting services: one government operated and one private. These two e-recruiting services were developed to help Canadian-trained individuals find work with Canadian employers and thus realize greater returns to Canadian investments in postsecondary education. Unfortunately, the potential of these services has thus far been only partially realized, and we suggest some reasons why this is so. We conclude with some suggestions for corrective measures that universities, the federal and provincial governments, business and political leaders, and individual Canadians might consider.

How e-Recruiting Works

E-recruiting services operate quite simply. The recruiting companies post job advertisements on their websites, which attract individuals who are looking for employment. Job seekers must register in order to use the full services of the site.[3] This registration infor-

1 For a list of e-recruiting sites, the vast majority of which are headquartered in the United States, see www.internetpost.com/internetpost/AlphaList.html.

2 This is a country-level counterpart of the often discussed problem firms face of investing education and training in workers who may then be recruited by other employers that can offer better wages for experienced workers trained elsewhere because they did not have to pay for the education and training of those workers.

3 This is true for open as well as closed e-recruiting services. Passwords are assigned as part of the registration process. One purpose of passwords is to enable the service provider to control access to user information stored on the...

mation can then be used by a commercial e-recruiting service or its owner for its business purposes, including selling selected excerpts to interested employers. Some e-recruiting services go beyond simply displaying job postings and job-seeker information by offering electronic matching and screening assistance for employers, job seekers, or both.[4] For example, many services give job seekers the option of being notified by e-mail when ads matching their stated job preferences are posted on the system. Also, most of the commercial services will sell employers access to electronic files of job-seeker qualifications and contact information.

Most e-recruiting services are free to those looking for work, but employers are charged a fee for posting job ads and another, higher fee for access to résumé files. These pricing policies have implications, especially for Canada, where a limited number of firms recruit large enough numbers for it to be in their interests to pay commercial fees for access to job-seeker qualifications and contact information. These access fees are reasonable for firms seeking hundreds of employees, not just a few.

The largest and most successful firms are those most willing and able to pay the highest prices for job-seeker information, and many of these are foreign. Thus, an e-recruiting service operating in Canada may choose to display mostly Canadian job postings while selling job-seeker information primarily to large foreign-

---

Note 3 - cont'd.

...site. That is, the passwords are utilized in much the same way that personal identification numbers help banks appropriately control access to account information and funds.

4 David Autor notes:

> The reasons that job boards have proliferated are clear. They offer more information, are easier to search, and are potentially more up to date than their textual counterpart, newspaper help wanted ads. In addition, job boards allow individuals to advertise their skills to employers as well as the reverse. Given the costs of online publishing relative to printing, job boards are also comparatively cheap. Placing a 30-day job advertisement on the largest job board, Monster.com, costs less than 5 percent of the price of running a help wanted advertisement in the Sunday *New York Times*. Estimates indicate that it also reaches potentially more visitors. (2001, 2.)

based companies because they are the ones willing to pay top dollar. In effect, the brain drain threat posed by e-recruiting services is a result of several factors. One is e-recruiters' ability to make money by obtaining job-seeker information in exchange for free access to job postings. Another reason is that most job seekers do not object to being considered by employers outside Canada, even if they themselves would not actively have sought foreign employment opportunities. A third factor is the economic reality that some global employers are willing — and able — to pay substantial amounts for information about skilled people looking for work. Finally, many workers in Canada are registered with, and give their qualifications and contact information to, these services, even though they are actually searching for other work opportunities at the time.

Most e-recruiting services have open websites that allow free access to all job searchers. Others, such as the e-recruiting sites of most university career centers and some of the services that were built with tax dollars, are "closed" — that is, restricted to those belonging to authorized groups.[5]

To understand e-recruiting, it is important to appreciate how these services fit into the whole recruiting process and to realize that they are not a replacement for most of what traditional employment services, including campus career centers, provide. In fact, no one should even consider cutting back on the funding of campus career centers because of the growth of e-recruiting. Indeed, as we will see, e-recruiting is undercutting the revenues from employer job postings that have been a financial mainstay for some campus career centers, which may necessitate increases in the levels of funding provided by universities to their campus career centers.

5 Some of these campus career centers will not even help the spouses of current students if those spouses were educated elsewhere, despite the fact that spouses often need help locating local employment in order to pay the tuition and living costs of their partners. Also, many spouses have postsecondary educational credentials and would be well suited for some of the jobs listed with the campus career centers. Nevertheless, the refusal to assist spouses educated elsewhere is reasonable considering how campus career centers are funded.

The process of finding a job, or filling one, can be broken down into eight steps for job seekers and employers, ranging from deciding to go to the job market to starting the new job (see Table 1).[6] To date, e-recruiting has revolutionized only the third step — finding work opportunities for job seekers and filling job openings for employers (steps JS3 and E3 in the table). Traditional employment services, such as campus career centers, continue to provide essential assistance to job seekers and employers in all areas, including steps JS3 and E3. For example, campus career centers schedule on-campus employer interviews for students and run cooperative education (co-op) programs.

Many people in both government and industry would like to know who is using e-recruiting, how much it is being used, and with what results. However, reliable information is not available at present due largely to the way e-recruiting operates. These services are communication providers that enable job seekers and employers to locate each other. Unlike the full-service personnel agencies, the e-recruiting services do not arrange employment matches. Those who use these services are not required — and in many cases would probably be unwilling — to report employment success resulting from their use of e-recruiting services. Thus, the e-recruiting services themselves have no direct way of knowing how many of those who visited their sites found employment or hired someone. What these services directly observe are things such as the numbers of people registered, the amounts of job postings and other services paid for by employers, and the numbers of visits to the site by various users.

Every e-recruiting service makes claims about their rising numbers of users,[7] but these should be taken with a grain of salt since

6 See Autor (2001) and Kuhn (2000) for analysis and evidence on how e-recruiting fits with and is affecting job search and employer recruiting in different types of labor markets.

7 All e-recruiting providers have an obvious interest in showing statistics that indicate high and rising use and high success rates. Some independent commercial agencies also claim to be able to provide traffic and other usage information for e-recruiting sites, but these agencies also have client-related vested interests in this information. In addition, a variety of technical and user...

Table 1: *The Eight Steps of the Job Search and Recruitment Process*

Job Seekers	Employers
JS1. The decision to look for a job	E1. The decision to look for an employee
JS2. Making a qualifications dossier	E2. Making a job description
JS3. Finding job openings to apply to	E3. Spreading information about the job opening
JS4. Assessing interested employers	E4. Examining applications from job seekers
JS5. Preparing and going for interviews	E5. Conducting interviews
JS6. Bargaining; assessing job offers	E6. Choosing among candidates; making offers
JS7. Accepting an offer	E7. Hiring a new worker
JS8. Starting work	E8. Having the new employee start work

these services are likely to report only statistics that are favorable to them. These organizations also control aspects of the services they operate that can greatly affect measures of site usage, which are collected using various accepted methods of monitoring. Even disinterested third-party providers of data on the e-recruiting industry may have difficulty collecting accurate information.

Even in the absence of good data, it seems obvious that the thousands of job postings now available on-line represent an important expansion in the information available to job seekers about employment opportunities. It is important to note, however, that most of the job postings on the main commercial e-recruiting services in both Canada and the United States are for big companies. Perhaps this is because they are best prepared to take advan-

Note 7 - cont'd.

> ...behavioral reasons make it difficult for anyone to collect accurate information about e-recruiting usage and success rates. We believe it is a mistake to treat most of the currently available information as reliable until more is known about the specifics of how the information was collected and processed, and until more thought has been given to the likely problems with the data. Statistics Canada recently began a data collection program covering limited aspects of e-recruiting and e-commerce. This is a much-needed development.

tage of the new e-recruiting technology, having had previous experience with their own electronic intranet systems for internal competitions for positions. In addition, big companies enjoy economies of scale in using e-recruiting services even for simple job postings. A single posting by a large corporation on an e-recruiting service for, say, an accountant can actually be an advertisement for dozens or even hundreds of open accounting positions.

The cost of posting job ads on a commercial e-recruiting site is much lower than the cost of gaining access to job-seeker data files. These fees are set so that they are reasonable for large employers trying to fill large numbers of positions, but they are probably prohibitively high for many smaller employers that have only one or two job openings at a time to fill. Being able to search job-seeker information files has important advantages over just posting job ads. Searching those files can, for example, help a recruiter find students nearing the completion of training programs in areas of high demand and identify those who are no longer actively seeking employment because they have already found jobs but who might be tempted by direct contact to consider a new job.

In summary, commercial e-recruiting services tend to charge prices that only larger companies are willing to pay because of the economies of scale they enjoy in making use of these services. From the point of view of e-recruiting companies, it is easier to deal with a few big employers with a large number of postings than with many smaller employers, each with just a few job ads.

Commercial e-Recruiting Services

In this section, we examine three of the most important commercial e-recruiting services operating in Canada, focusing on their corporate connections and business models for commercial services. In addition to selling job postings and electronic access to job-seeker information files, for-profit e-recruiting services exhibit important commercial complementarities with certain other sorts of businesses. Some of the associated commercial activities can increase the likelihood that job seekers who start out looking for work in Canada may end up considering jobs with large US or global companies instead.

The two largest commercial e-recruiters headquartered and operating only in Canada are Workopolis and CareerClick. Although both services help connect Canadian job seekers with mainly Canadian employers, both also belong to businesses with global interests. Workopolis is the result of an alliance between Globe Information Services (part of The Thomson Corporation) and Toronto Star Newspapers Ltd. As a result of business amalgamations, CareerClick came to be owned, along with the *National Post* and other newspapers, by Winnipeg-based CanWest Global Communications Corp., another company with global corporate affiliations and interests.

The dominant foreign-based e-recruiting service operating in Canada is Monster.ca, the Canadian site of Monster.com.[8] The Monster family of sites is controlled by TMP Worldwide, a long established US-based personnel and marketing agency network. As a Monster.ca newswire release explains:

> Monster is the flagship brand of the Interactive Division of TMP Worldwide Inc.....Founded in 1967, TMP Worldwide...is the online recruitment leader, the world's largest recruitment advertising agency network, and one of the world's largest search and selection agencies. TMP Worldwide, headquartered in New York, is also the world's largest Yellow Pages advertising agency and a provider of direct marketing services. The company's clients include more than 90 of the Fortune 100 and more than 480 of the Fortune 500 companies. (Monster.ca, Press release, February 27, 2001.)

As already noted, commercial e-recruiting services are typically free for job seekers but charge employers hundreds of dollars to post a job ad and thousands for access to files of job-seeker qualifications and contact information. Price information for Workopolis, CareerClick, and Monster for a single job posting and for access to job-seeker qualifications and contact information files is summarized in Table 2.[9]

8 As of August 2000, Monster.com contained 3.9 million résumés and 430,000 jobs (Autor 2001, 35).

9 The fees that employers must pay are not usually displayed to job seekers on the e-recruiting sites. In fact, some e-recruiting services do not display this information on their sites even in the employer information sections; instead, employers are instructed to call for information about fees.

Table 2: ***Charges for Selected Major For-Profit e-Recruiting Services Operating in Canada***

	Cost	Corporate Affiliation
Workopolis (www.workopolis.com)	$500 for a single job posting for 21 days $1,500 per month, or $4,500 for one year, to search the résumé database	Globe Interactive, part of The Thomson Corporation
CareerClick (www.careerclick.com)	$500 for a single job posting for 21 days $450 per month, or $5,400 for one year, to search the résumé database	CanWest Global Communications Corp.
The Monster Board (www.monster.ca; www.monster.com)	$295 for a single job posting for 60 days for a single location and job category; $225 for each additional location or category $1,450 to search the résumé database for three months	TMP Worldwide

Note: Information collected during the first week of September 2000.

The revenues from the fees employers pay for job postings and for access to résumé files are only part of the economic benefits a parent company can potentially reap from owning an e-recruiting service. As already noted, e-recruiting services are a potential complement to certain other business activities. For instance, Workopolis and CareerClick are helping to protect the viability of newspaper classified ads in an Internet era. Both also have associations with full-service recruiting agencies with large corporate clients headquartered outside as well as in Canada (that is, they have associations with global headhunters). The Monster Board enhances TMP Worldwide's established full-service personnel agency network, its Yellow Pages business, and its direct marketing operations. The high

value of the Monster-TMP Worldwide complementarities may be part of the reason Monster.ca is able to charge lower fees for some of its e-recruiting services than Workopolis or CareerClick.

There is no public information on the extent to which these obvious sorts of complementarities are financially important for commercial e-recruiting services, but the possibilities are clear. For instance, a full-service global headhunter operating in conjunction with an e-recruiting service could identify and skim off the most commercially valuable job seekers who register with the e-recruiter. This skimming off could occur even before the employers paying to search job-seeker qualifications and contact information files have had a chance to find and contact job seekers.[10]

Nonprofit e-Recruitment Services

E-recruiting services can complement not only other established for-profit business activities, but government services as well. As

10 JobShark, another commercial e-recruiting service operating in Canada, appears to recognize this skimming practice. In November 2001, its website stated:

> Through its proprietary matching technology, called JAWS, jobshark.com matches on skill sets and then notifies prospective candidates by email of matching job postings directly to qualified candidates. The principal is based on sourcing local people for local jobs, but with JobShark's growing global network of countries, international searches have become very much the reality. Globally, JobShark has the largest skill set profile database in the industry, with over 750,000 résumés and profiles of job seekers, with over 430,000 in Canada and over 250,000 in Latin America and over 60,000 in the UK. By prescreening applicants through the matching process, jobshark.com provides higher quality candidates for recruiters, and an effortless way for job seekers to find out about exciting new opportunities. Because jobshark.com's database is private and nonsearchable, job seekers are assured of 100% confidentiality, and *recruiters can be sure that the cream of the crop has not been skimmed* [italics added]. JobShark has over 1,000 corporate clients.

JobShark thus used to claim, in effect, that all employers who paid to use their JAWS search capabilities would receive the same good value because JobShark did not have a full-service headhunter operating in the background and did not sell direct access to their job-seeker registration information to anyone.

Nakamura and Lawrence (1993) and Nakamura (1995) suggested when Internet use was first starting to accelerate, e-recruiting services could enhance the return on public investments in postsecondary education by making it cheaper and easier for Canadian employers to locate and communicate with Canadian-trained postsecondary students and alumni.[11]

The labor markets for advanced skills are highly fragmented, which forces those with specialized skills to conduct wide searches for a suitable employer.[12] For example, in most smaller Canadian cities and towns, there are job openings for retail clerks or laborers, but not for brain surgeons or theoretical physicists.[13] Thus, Canadian university students need access to career placement services that are national or even global in scope. E-recruiting technology enables wide, low-cost searches for both job seekers and employers.

In the early 1990s, most university campus career centers did not have websites or e-recruiting services, and the anticipated cost of building these at each school was high and viewed by some as a wasteful duplication of effort. But with the encouragement of several university presidents, the federal ministers of Industry and Human Resources Development committed funds to building a postsecondary-level e-recruiting service. That service, inaugurated by Industry Canada in 1995, is now known as Campus WorkLink.[14] Currently, the service charges employers between $20 and $449 for a single job posting, depending on the number of postsecondary institution job-seeker groups the employer wants the posting to be

11 Including those who had received a degree as well as those who had taken university courses but had left before graduating.

12 Economists have been making this argument for a long time. Diewert (2001) provides references and thoughtful commentary on this point.

13 It should, however, be noted that, although people tend to assume a general shortage of employment opportunities also means an absence of job openings for highly specialized workers, this is not always the case. Openings for medical and other specialists sometimes exist in parts of the country where unemployment in general is high.

14 For more on the development of www.campusworklink.com, see Nakamura, Wong, and Diewert (1999), and Nakamura and Pugh (2001).

displayed to and the length of time it will be on the system. Many employers, ranging from large institutions such as the Bank of Canada, to small volunteer operations, report success using Campus WorkLink.

Campus WorkLink has, however, faced constraints resulting from the fact that it was built with tax dollars. While it was still being developed, a private sector e-recruiting company brought charges of unfair government competition. Since university-educated workers are the premium market for private sector recruiters and since they usually have below-average unemployment rates, it is difficult to justify government intervention in postsecondary labor markets on the grounds of market failure.

In the United States, the federal government did not develop e-recruiting services for postsecondary recruiting but instead allowed commercial providers to fill this need. The dominant commercial e-recruiting service for US universities and colleges is JOBTRAK.COM, which provides résumé database and interview scheduling software support as well as e-recruiting services for more than 1,100 US university and college campus career centers. In November 2000, JOBTRAK was acquired by Monster.com and became a talent feeder system for it. This alliance demonstrates that there can also be interesting complementarities among different sorts of e-recruiting services as well as between e-recruiting services and other sorts of businesses.

In Canada, the private sector challenge to Campus WorkLink was resolved by an agreement that limited use of its services to students and recent alumni of Canadian postsecondary institutions that agreed to participate. "Recent alumni" are defined as those who have ended their postsecondary studies within the previous three years. Under the terms of the agreement, directors at each campus career center had the right to opt out of the Campus WorkLink system, and almost all of them did at first. University participation remained poor in the first years after the service went on-line. By now, however, most Canadian postsecondary institutions have signed Campus WorkLink partnership agreements through their campus career placement offices. (See the Appendix for a list of partnered institutions.)

A Private, Nonprofit Complement to e-Recruitment Services

Campus WorkLink now provides thousands of Canadian employers affordable access to the students and alumni of Canadian postsecondary institutions, a success that confirms the forecast by Nakamura and Lawrence (1993) that employers and postsecondary level job seekers would avail themselves of this sort of low-cost e-recruiting service if it were available to them.

As of 1998, however, large numbers of Canadian postsecondary students and graduates still could not access job postings through Campus WorkLink because the campus career centers of several institutions, including the universities of Alberta and Western Ontario, had not agreed to participate. And even at those institutions that were part of Campus WorkLink, relatively small fractions of the students had bothered to get their Campus WorkLink passwords. Also, anyone, whether Canadian-born or an immigrant, who had graduated more than three years earlier or who had taken their postsecondary training outside the country, was ineligible to receive targeted job postings through the Campus WorkLink system.[15] This situation motivated Nakamura and others to set up a new e-recruiting service to complement the coverage of Campus WorkLink.

Faculty members across the country volunteered time and money to create the nonprofit CareerOwl e-recruiting service, which was built with private donations, not university funds or tax dollars, to avoid the problems of Campus WorkLink.[16] CareerOwl

15 Although this part of the agreement was not enforced, it nevertheless served to forestall active initiatives to sign up the alumni at large for universities that partnered with Campus WorkLink. This constraint will become more serious if structural changes in the economy mean that growing numbers of experienced workers with postsecondary credentials must change jobs many times over the course of their careers. See Picot, Heisz, and Nakamura (2000) for empirical evidence on this point.

16 For background on CareerOwl, including the way in which some of the key ideas and collaborative relationships grew out of funded research provided by the Social Sciences and Humanities Research Council of Canada, see Nakamura et al. (1999). There is also a French-language Owl (www.chouettecarriere.ca). The CareerOwl system, both English and French, is managed by the CareerOwl...

went on-line in September 1999 and became fully operational in March 2000. The service has special features to facilitate job search and employer recruiting, such as confidential direct messaging. In addition, CareerOwl is open to all: anyone can sign up and receive a password. Users choose their own passwords on-line, which are used solely to allow job seekers to maintain control over who can access or change personal information stored on the system.

Regular job postings for Canadian jobs can be advertised on CareerOwl for up to eight weeks for a flat fee of $25 each. Ads for jobs in other countries can be posted by both domestic and foreign companies, but at a cost of $100 each. A unique feature of CareerOwl is the ability of employers to search job candidates' qualification profiles on-line at any time for free or a nominal $25 fee, which allows smaller and medium-size Canadian businesses to use this search option.[17]

More than 75,000 Canadian students and graduates from more than 500 postsecondary institutions — including more than 200 that are not part of the Campus WorkLink system — now use CareerOwl.[18] Canadians who went to foreign postsecondary insti-

---

Note 16 - cont'd.

...Institute, a Canadian nonprofit, noncharitable organization. As a noncharitable organization, CareerOwl claimed no tax writeoffs for the start-up funds donated to create it.

17 We believe that small companies potentially have at least as much to gain from using e-recruiting as big companies do in terms of help with finding needed talent, provided, of course, that they can afford to use such services. Small companies typically lack large personnel offices and budgets for advertising widely and for sending recruiters far afield in search of promising candidates for open positions, all of which is standard for big companies. Helping small companies with their personnel problems is important for ensuring this country's future prosperity.

18 CareerOwl users include more than 10,000 students and alumni of the universities of Alberta and Western Ontario, the two largest postsecondary institutions that have not joined Campus WorkLink. The presidents of both the University of Alberta and the University of Western Ontario have been part of the faculty volunteer support base for CareerOwl from the start. Their statement of support, which is also signed by the president of the University of British Columbia, can be found on the CareerOwl website.

tutions, which are not eligible to partner with Campus WorkLink, are also using CareerOwl in rising numbers.[19]

Resistance to Campus WorkLink and CareerOwl

Both Campus WorkLink and CareerOwl are now being used regularly by large numbers of Canadian job seekers and employers, but there are still many who have not even heard of either one, implying that the value of these services for Canadian employers is less than it could be. One reason is that some university career centers do not take the trouble to tell students and graduates about these e-recruiting services, favoring instead other commercial e-recruiting services such as Monster.ca and Monster.com.

We are not arguing that campus career centers should ignore commercial e-recruiting services, which many postsecondary students and alumni likely find useful. But it seems unreasonable to us for campus career centers to give such prominence to expensive (for employers) commercial services while ignoring or downplaying government and nonprofit sites. We suspect the reason they do so relates to the way in which many campus offices are set up and paid for, as well as to the nature of the funding and performance measurement arrangements of the universities themselves. A little history about the evolution of career services on Canadian university campuses is helpful for understanding this point.

The Evolution of Campus Career Placement Services

In the 1970s, Canada was ahead of the United States in providing accessible, nationwide job placement services for university-trained

19 For students and alumni who are eligible to use Campus WorkLink, information on this service and a direct link to Campus WorkLink are provided on the CareerOwl website. In fact, the website has a job-seeker resources section with links to hundreds of federal and provincial government, nonprofit, and commercial e-recruiting, and other employment information websites that may be useful to Canadian job seekers.

talent. Canada Manpower offices on Canadian university campuses were open to anyone eligible to work in this country. However, these offices were closed in the 1980s as a federal cost-cutting measure and were replaced by university-run campus career centers. Then, as now, these came in two varieties — one serving the whole campus, and the other for the business faculty only. In most cases, neither type of career center assists students or alumni from other postsecondary institutions.

From the start, universities provided little direct funding for their main career centers, many of which, as a result, came to rely heavily on the fees they charged employers for posting their job ads.[20] In contrast, career centers run by business faculties typically had base operating budgets, which is probably why most still do not charge employers for displaying their job postings.[21] Most business faculties regard their career centers as giving them a competitive edge in attracting top students and building relationships with potential donors.

Funding arrangements for the two types of career centers invite noncooperation between them. To their credit, most directors of career centers manage to rise above the dictates of the underlying economic signals, but incentives for noncooperation with other career centers, even at the same university, are strong. In addition, universities, colleges, and technical schools compete with each other for their public budget allocations. Real and rumored information about employment opportunities for students of the various institutions plays a role in this budgetary process in most provinces. This institutional funding situation reinforces the territorial incentives of career center funding arrangements, and might be part of the reason senior administrators at some postsecondary institutions have failed to act on complaints from the business community and recruiters about the territoriality of some campus career centers.

---

20 These career centers have, however, usually been provided with in-kind support, such as space. In addition, some have been given shares of the student union or other student activity fees.

21 Some business faculty career centers raise funds from employers or students by, for example, running cooperative education programs or collecting a portion of what employers pay as remuneration for co-op students.

Until e-recruiting became widely available, most campus career centers had a virtual monopoly on the provision of local career services, and employers who wanted university-trained employees could not avoid dealing with them. E-recruiting has, however, disrupted this monopoly. In private discussions with the authors of this paper, some career center directors have explained that, from their perspective, the higher-priced commercial e-recruiting services do not pose a competitive threat, partly because they charge fees that are substantially above those of the main campus career centers. Nonetheless, government and nonprofit services that charge employers nominal fees have been treated as a threat on some campuses, and they have reacted by trying to partner with US-based Monster, a move that could give them a more secure revenue base while reducing their job-posting costs.

In February 2001, Monster.ca announced it would be "offering free software that is focused on the needs of the career centers as well as co-op programs, and a split-revenue solution" (Monster.ca, Press release, February 27, 2001). This offer would almost surely be more financially rewarding for many campus offices than anything Campus WorkLink or CareerOwl could provide. The latter services aim to hold down the costs of recruiting for Canadian employers and hence cannot provide revenue to campus career centers in the amounts Monster is now offering. Already, Montreal's Concordia University has said it would take up Monster's offer, and unless university administrators or provincial or federal governments move quickly, many other campus career centers could follow Concordia's example.

Questions Raised

E-recruiting has made it easier and cheaper for all employers to find and communicate with Canadian job seekers. In the past, foreign recruiters were always able to entice away some of Canada's most accomplished university graduates,[22] although they had to mount expensive recruiting campaigns to collect information about

22 For information on the brain drain and references to the related literature on this topic, see Kesselman (2001).

and attract available Canadian job seekers. E-recruiting is, however, eroding still further the home-country advantage of Canadian employers in finding and contacting Canadian talent. The candidate search phase of recruiting can now be conducted almost as cheaply from Silicon Valley or Wall Street as from Ottawa, Toronto, or Vancouver. We are concerned that, with better access to information through e-recruiting services, US and other foreign companies may become quicker and better at locating valuable Canadian postsecondary graduates with the scarce skills everyone seeks.

What, then, are the broad questions about e-recruiting in Canada that need to be addressed? For example, how should information about the various e-recruiting sites be presented to Canadians? Some materials put out by governments and campus career centers seem to favor the largest e-recruiting websites.[23] Is this strategy in the best interest of Canada if it results in preferential advertising for US-dominated e-recruiting sites? Is global or even national size what matters most? Some employers that use e-recruiting report that the presence of candidates with the qualifications they require is more important than size.[24] Does it matter that firms heavily engaged in direct marketing for foreign clients own or have close

23 See, for example, Canada (2001). This booklet, sponsored by Human Resources Development Canada and distributed Canada-wide, lists Monster.ca ahead of the Canadian for-profit sites Workopolis and CareerClick and well ahead of the nonprofit CareerOwl.ca and Canadian-government-sponsored sites such as Campus WorkLink. In an updated, online version of an article that appeared in CAREER OPTIONS, another publication widely distributed to Canadian university students and campus career centers, Sara Newton-Smith, writing for the Canadian Association of Career Educators and Employers (CACEE), lists the 40 sites as the "Top Websites for Your Job Search." Her list is alphabetical; hence, Monster.ca appears after Campus WorkLink and Careerclick, but CareerOwl.ca is not listed, although numerous commercial sites are. Her introductory remarks single out Monster.ca along with the Industry Canada/CACEE-run CampusWorkLink.com e-recruiting service for special mention. On Monster.ca, she writes that it provides "job matching services that let you create your own job search agent and have job prospects e-mailed directly to you!" The latter is a service that CareerOwl has been providing since 1999, as a technological leader at that time. See www.cacee.com/co2000/2007.html.

24 Warburton and Warburton (2001) make this point for a Canadian recruiting example.

business associations with some of the e-recruiting sites being promoted to Canadian job seekers?

Will the qualifications and contact information that Canadian job seekers enter when registering to use e-recruiting sites such as Monster.ca be equally available to Canadian and US companies for hiring and direct marketing purposes? Monster reports that the clients of its parent, TMP Worldwide, "include more than 90 of the Fortune 100 and more than 480 of the Fortune 500 companies" (Monster.ca. Press release, February 27, 2001). How many Canadian companies can afford such services? More generally, will foreign-based e-recruiting services be knowledgeable about and responsive to the special circumstances of Canadian job seekers and employers?[25]

Job seekers incur no dollar costs for using most e-recruiting services, but employers usually pay, and the fees charged for commercial services are usually higher than they are for nonprofits such as Campus WorkLink or CareerOwl. Perhaps more Canadians would register with noncommercial services if they realized that doing so could translate into cost savings for Canadian companies, which could then be used for better wages and market development. Should campus career centers do more to help Canadian job seekers and employers learn about such lower-cost e-recruiting services? Who, on campuses, is answerable for choices that affect the costs to employers of contacting the students their tax dollars helped to educate?

Recommendations

Since Canadian postsecondary institutions are partially supported by taxes, is it in the economic best interest of Canadian taxpayers when those trained at Canadian schools take jobs with foreign companies in other countries? Because freedom of information and of

25 The press release just cited claims, incorrectly, that "Monster.ca is the first and only national bilingual recruiting services Web site in Canada." In fact, virtually all government and private sector for-profit and nonprofit e-recruiting services operating in Canada offer bilingual services.

movement are important rights, we do not believe Canadian graduates should be discouraged from exploring foreign job opportunities. We do, however, recommend that campus career centers do more to help Canadians find out about e-recruiting services that are designed and operated first and foremost to help connect Canadian employers with Canadian-trained talent.

We also recommend that the schools and provincial governments review the funding, reporting, and performance assessment arrangements for campus career centers, and that the centers be given guidelines and incentives to participate in the Campus WorkLink system and to display relevant information for other e-recruiting websites, particularly those with a mission to connect Canadian employers with Canadian job seekers.

The current mechanisms for delivering financial support to schools and for judging the success of the graduates of these institutions encourage these institutions and their career centers to be territorial about their role in job placement. In this regard, we recommend careful consideration of alternative funding arrangements for universities, such as those considered by Davenport (in this volume), Diewert (2001), and Morck (1995).

A key goal should be to better align the interests of those who foot the bills for Canadian educational institutions with those who design the services offered by their campus career placement offices. The rules and incentives under which these centers operate should encourage them to ensure that human capital developed at the expense of Canadian taxpayers is at least as accessible to Canadian employers as it is to their foreign competitors.

Appendix: Canadian Postsecondary Institutions Partnered with Campus WorkLink*

Acadia University
Alberta College of Art and Design
Algoma University College
Algonquin College
Assiniboine Community College
Athabasca University
Bishop's University
Brandon University
British Columbia Institute of Technology
Brock University
Cambrian College
Camosun College
Canadian Information Technology College
Canadore College
Cape Breton Business College
Capilano College
Carleton University
CDI College — Laval
CDI College — Nepean
CDI College — Ottawa
Cégep de Chicoutimi
Cégep de Gaspésie et des Iles
Cégep de Jonquière
Cégep de l'Abitibi-Témiscamingue
Cégep de Rimouski
Cégep de Rivière-du-Loup
Cégep de Sainte-Foy
Cégep de Saint-Laurent
Cégep de Sept-Iles
Cégep de Trois-Rivières
Cégep du Vieux-Montréal
Cégep Heritage College
Centennial College
Champlain Regional College — St-Lambert
Champlain St.Lawrence
Champlain — Lennoxville
Collège Ahuntsic
Collège Boréal
Collège communautaire du Nouveau-Brunswick — Bathurst
Collège communautaire du Nouveau-Brunswick — Campbellton
Collège communautaire du Nouveau-Brunswick — Dieppe
Collège communautaire du Nouveau-Brunswick — Edmunston
Collège d'Alma
Collège de Bois-de-Boulogne
Collège de l'Acadie
Collège de l'Outaouais
Collège de Maisonneuve
Collège de Sherbrooke
Collège des Grands Lacs
Collège Édouard-Montpetit
Collège Laflèche
Collège Lionel-Groulx
Collège Montmorency
Collège MultiHexa Ste-Foy
College of New Caledonia
College of the North Atlantic — Bonavista
College of the North Atlantic — Cornerbrook
College of the North Atlantic — Gander
College of the North Atlantic — Grand Falls
College of the North Atlantic — Labrador City
College of the North Atlantic — Ridge Road
College of the North Atlantic — St. John's

* Information current as of July 14, 2001.

College of the North Atlantic — Stephenville
College of the Rockies
CompuCollege School of Business — New Brunswick
CompuCollege School of Business — Prince Edward Island
Concordia University
Conestoga College
Confederation College
Dalhousie University
DALTECH
Dawson College
Devry Institute of Technology — Calgary
Douglas College
Durham College
École de Technologie Supérieure
École des Hautes Études Commerciales
École nationale d'administration publiique
Emily Carr College of Art and Design
Fanshawe College
George Brown College
Georgian College
Grant MacEwan Community College
Holland College
Humber College
Information Technology Institute — Calgary
Information Technology Institute — Halifax
Information Technology Institute — Ontario
The Institute for Computer Studies — Ottawa
The Institute for Computer Studies — North York
John Abbott College
Justice Institute of British Columbia
Kemptville College of Agricultural Technology
Keyano College
Kwantlen University College
La Cité collegialé
Lakehead University
Lambton College
Langara College
Laurentian University
Lethbridge Community College
Loyalist College
McGill University (including MacDonald Campus)
McMaster University
Malaspina University-College
Medicine Hat College
Memorial University of Newfoundland
The Michener Institute of Applied Arts
Mohawk College
Mount Allison University
Mount Royal College
Mount St. Vincent University
New Brunswick Community College — Moncton
New Brunswick Community College — Saint John
New Brunswick Community College — St. Andrew's
New Brunswick Community College — Woodstock
Niagara College
Nicola Valley Institute of Technology
Nipissing University
NorQuest College
North Island College
Northern College of Applied Arts and Technology
Northern Lakes College
Nova Scotia Agricultural College
Nova Scotia College of Art and Design
Nova Scotia Community College — Annapolis Valley Campus and Pictou Campus
Olds College
Ontario College of Art and Design
Ontario Institute of Information Technology
Queen's University
Red Deer College
Red River College
Royal Roads University
Ryerson University
St. Clair College
St. Francis Xavier University

St. Lawrence College
Saint Mary's University
Saskatchewan Institute of Applied Science and Technology — Kelsey Campus and Woodland Campus
Sault College of Applied Arts & Technology
Seneca College
Sheridan College
Simon Fraser University
Sir Sandford Fleming College — Frost Campus and Sutherland Campus
Technical University of British Columbia
Toronto School of Business/Compu College (General)
Trent University
Trinity Western University
Université de Moncton
Université de Montréal
Université de Sherbrooke
Université du Québec à Chicoutimi
Université du Québec à Hull
Université du Québec à Montréal
Université du Québec à Rimouski
Université du Québec à Trois-Rivières
Université du Québec en Abitibi-Témiscamingue
Université Laval
University College of Cape Breton
University College of the Cariboo
University College of the Fraser Valley
University of British Columbia
University of Calgary
University of Guelph
University of Lethbridge
University of Manitoba
University of New Brunswick — Fredericton
University of New Brunswick — Saint John
University of Northern B.C.
University of Ottawa
University of Prince Edward Island
University of Regina
University of Saskatchewan
University of Toronto
University of Victoria
University of Waterloo
University of Windsor
University of Winnipeg
Wilfrid Laurier University
York University

References

Autor, David. 2001. "Wiring the Labor Market." *Journal of Economic Perspectives* 15 (Winter): 35–40.

Canada. 2001. Department of Human Resources Development. "Top 100 Internet Sites for Learning and Employment." Ottawa.

Courchene, Thomas J. 2001. *A State of Minds: Toward a Human Capital Future for Canadians*. Montreal: Institute for Research on Public Policy.

Diewert, W. Erwin. 2001. "Productivity Growth and the Role of Government." Discussion Paper 01-13. Vancouver: University of British Columbia, Department of Economics. Available from Internet website: www.econ.ubc.ca/diewert/hmpgdie.htm.

Kesselman, Jonathan R. 2001. "Policies to Stem the Brain Drain — Without Americanizing Canada." *Canadian Public Policy* 27 (1): 77–94.

Kuhn, Peter. 2000. "Policies for an Internet Labour Market." *Policy Options* 21 (8): 42–47.

Morck, Randall K. 1995. "A Plan for Making Public Universities Financially Independent." Working Paper. Edmonton: University of Alberta, Faculty of Business.

Nakamura, Alice O. 1995. "New Directions for UI, Social Assistance, and Vocational Education and Training." Presidential Address delivered to the annual meetings of the Canadian Economics Association, Université du Québec à Montréal, June 3, 1995; published in *Canadian Journal of Economics* 28 (November): 731–754.

———, et al. 1999. "The Genesis of CareerOwl: The Story of How SSHRC Funded University Research Led to an On-Line Electronic Hiring Hall for Canadian Post Secondary Students and Alumni." Available from Internet website: www.CareerOwl.ca.

———, and Peter Lawrence. 1993. "Education, Training and Prosperity." PEER Group Working Paper 93-12-1, 1-50. Subsequently published in revised form in Thomas J. Courchene, ed., *Stabilization, Growth and Distribution: Linkages in the Knowledge Era*. Kingston, Ont.: Queen's University, John Deutsch Institute for the Study of Economic Policy.

———, and T. Pugh. 2001. "Our Governments Should Stop Freezing Out Smaller Canadian e-Recruiters." *Policy Options* 21 (8): 48–52.

———, G. Wong, and W.E. Diewert. 1999. "New Approaches to Public Income Support in Canada." In Organisation for Economic Co-operation and Development, *The Local Dimension of Welfare-to-Work: An International Survey*. Paris: OECD.

Picot, Garnett, Andrew Heisz, and Alice Nakamura. 2000. "Were 1990s Labour Markets Really Different?" *Policy Options* 21 (6): 15–26.

Warburton, R.N., and W.P. Warburton. 2001. "Canadian-Made e-Solution Proves Cheap and Effective." *Canadian Business Economics* 8 (3): 37–39.

Comments on Davenport, Easton, and Nakamura and Bruneau

Melville L. McMillan

The papers that I comment on address three important aspects of university education: Paul Davenport examines the production process students are exposed to while in Canadian universities; Stephen Easton looks at who is going to them; and Alice Nakamura and Joel Bruneau consider how students subsequently make the transition from university to work — that is, get jobs — in the world of e-recruiting.[1] While the papers constitute a natural package with a fairly consistent outlook, there is little overlap among them. Hence, I discuss each paper independently in the order just mentioned.

Paul Davenport on University Resources, Knowledge Transfer, and Production: What's Going On in the "Barn"?

Paul Davenport presents an excellent overview of what has happened at Canadian universities over the past couple of decades, where they are at today, and what the issues of the future are. Davenport's message is clear: First, there is a strong demand for university graduates. Second, there has been a major and serious erosion of university resources, which a shift to more tied but

1 The other four papers focus more on the output of universities in terms of research and labor market experience, paying particular attention to indicators of quality and value.

incomplete research funding has exacerbated for the general university budget. Third, concern exists as to whether or not we can maintain, let alone improve upon, our already eroded institutional quality over the next decade in the face of another surge in enrollments, substantial retirements, and strong competition for faculty from the United States and elsewhere. As steps toward solving these problems, Davenport recommends pursuing a 10 percent reduction in the student-to-faculty ratio through extra recruitment, increased direct and indirect research support, and the establishment of an income-contingent student loan system to facilitate student access.

One cannot argue with Davenport's assessment of the situation nor take exception to the recommendations. More can be said, however, especially about the recommendations. Before following that line of thought, however, I will insert a comment on the strong demand for university graduates. It is this strong demand that has maintained the earnings of university graduates despite the rapid expansion in their numbers, and especially in the number of women graduates. Also, in support of Davenport's position on the education needs of the knowledge economy, I point to Robert Allen's observations that there is demand for both builders and users (Allen 1999). That is, while the new information economy requires — and universities are called on to supply — those capable of conceptualizing, designing, and building infrastructure, there is a parallel demand created for the people who understand, know how to use, and can exploit the potential of those systems and the information that they deliver. Hence, and as other contributors have indicated, the strong demand for university graduates will continue to be broadly based, not simply focused on computer scientists and engineers.

Davenport's recommendations are definitely a step in the right direction, but they suggest some need for further study and even research. The case for reducing the student-faculty ratio is based on an assumption about educational quality: that a 10 percent reduction in this ratio will partially restore the quality of undergraduate education that a 25 percent increase over recent years has undermined. Universities have little objective evidence, however, on which to say with confidence what improvement in quality would

result from such a change, or even what might be optimal ratios on average, let alone for a particular year or faculty. Nor is there much evidence about what instruction methods are superior. We might benefit from more investigation into university teaching. While the results that could be obtained from formal analysis in this matter may be limited, universities do have lots of experience with teaching. There should be a healthy respect for the lessons learned and the intuition gained in practice. The management of university teaching resources may be quite good at realizing results for the same reasons that good business managers can succeed in their markets despite being unfamiliar with the theory of marginal revenue and marginal cost.

There is some evidence that students are willing to pay significant premiums for "quality" programs involving smaller class sizes. Those premiums may not reflect well the improved quality of either the university inputs or of the students enrolled, but rather, at least in part, the willingness to pay for the exclusivity, prestige, and recognition associated with such programs, which is effective in propelling those students to the forefront in the job market competition.[2] Universities, and the governments supporting them, must ensure that preferred learning environments are made available not only to those able to pay a premium but also to those best able to benefit; at the same time, they must provide quality education to all university students. Doing so is a challenge in an environment of limited resources, retiring faculty, and increasing student numbers.

Canada devotes considerable resources to postsecondary education. As Davenport takes care to point out, relative to other countries, an extraordinary share of that goes to nonuniversity programs. The promotion of these programs and the pressures to expand them have been substantial and have challenged universities (see, for example, Allen 1999). Has this emphasis served Canada well, or might the country better consider other options for producing those skills and reallocate public funding to university education, which demonstrates attractive rates of return?

2 Convenience can be another valuable attribute of these programs, especially those catering to employed students.

Davenport makes the point that the low level of university research funding in Canada, especially relative to comparable programs in the United States, argues for increased funding, especially if leading researchers are to be retained. Given the shortage of research funding available, it would be helpful to investigate how existing and new funds could be used most effectively to enhance research productivity — by affecting, for example, the kinds of indicators that Chant and Gibson explore in their paper in this volume. Where should new money go? Where would it have the greatest impact? Is the current allocation among and within funding councils, among disciplines and programs, the most effective? Are the many specific-purpose and "strings-attached" programs effective or constraining? There seems to have been little research into research and research funding.

Income-contingent loans for students are a reasonable suggestion. The idea has been discussed for some time, and such loans do exist in some countries (such as Australia). Davenport does not outline the income-contingent program he foresees. This is unfortunate, because this is clearly a program for which "the devil is in the details." What role and what impact would the loan program have? Would it be a backstop option for a few or a mainstream program for most? Would the distribution of the burden differ much from that of the existing tax system? Would it promote better decision making by students, the universities, or government? Might it promote further student indebtedness? Would it prompt further tuition increases?[3] Essentially, would this contingent loan program enhance access, or would it primarily modify university finance? the idea of income-contingent loans for university students clearly deserves further investigation.

So far, my comments have been the academic's usual fallback: tossing out caveats and calling for more research. I change direc-

3 The scope for further tuition increases may be limited in some programs where tuition already approaches instruction costs. Thus, increasing tuition raises the possibility of further differentiating tuition fees, as Rathje and Emery suggest in their essay. This prospect has various pros and cons. See Smith's comments on the topic elsewhere in this volume and Litten (1984) and Stager (1989) for other perspectives.

tion here to extend somewhat the analysis of Davenport's paper. I reflect on three issues: student input into the knowledge production process, the potential federal role in university finance and, the resulting implications for the provinces.

Davenport is concerned about the decline in university funding and the impact, especially through the increasing student-faculty ratio, that it has on quality education. I call attention here to another resource of the education production process that appears to be declining: student input. I refer here not to the *number* of students, which continues to increase, but to the *time* that students devote to their university education. In 1991, the Smith Commission reported that a survey of arts and science undergraduates revealed that 45 percent were employed either on or off campus (Smith 1991). It also reported that, between 1975 and 1990, the percentage of full-time university students who were employed increased from 26 to 38 percent, with less than one-third of these working fewer than 10 hours per week.[4] I do not have comparable data for the 1990s, but the Labour Force Survey reports that, although student labor force participation rates have declined sharply since 1989, for students in the 20-to-24 age range (that is, the typical postsecondary range), it has remained relatively constant.[5] While this information does not refer specifically to university students, casual observation and anecdotal evidence certainly give no indication of any abatement. The growth in the employment of *full-time* students, plus their longer hours, suggests that there is less time available for — and hence less time devoted to — university studies. I am sure that many academics can testify to observing this trend and to the impact that it has had on their classes and on student learning. Also, because teaching methods may be modified in the face of this trend — for example, fewer assignments — and competition among

4 About 40 percent of those employed work 10–19 hours per week. The largest increases were in the groups of students working 10–19 and 20–29 hours per week.

5 For example, see Jennings (1998). In a recent survey (1,407 responses), the University of Calgary Students' Union found that students were, on average, working 17.5 hours per week during the school year.

students reduced, the whole class, not just those working, may be affected.

Thus, the quality of university education may be being eroded by reduced input not only from the university, but from the student. Universities need to consider that they may have accommodated this trend by adjusting their performance expectations for full-time students.[6] Any attention paid to concerns about the quality of university undergraduate education needs to address student employment: the extent that it detracts from university studies and the pressures underlying it.

Davenport has legitimate reasons to lament the underfunding of research at Canadian universities and to call for a larger federal contribution. An expanded federal role for research support is logical. The products of research are highly mobile and the benefits spread widely. Hence, provinces may be reluctant to invest as heavily in research as the federal government, which can internalize more of the benefits. There has been some expansion of federal research funding lately, but the new funds are focused on the direct costs of research, such as equipment, supplies, technical support, and some student support. Indirect or overhead costs have been neglected — the space, services, utilities, and libraries that provide necessary support.[7] When the funding does not cover all the costs associated with a research effort, operating funds end up being diverted from other parts of the university. One result is less money to hire faculty. Ironically, faculty are the key ingredient of research. Yet the federal government does not share in the salary expenses of university faculty, although they devote a considerable portion of their time to research. Federal research funding, like most other kinds, covers only those "extras" that faculty must have to do research. This approach distorts the university's allocation of resources and may make the object of more and better research more difficult to achieve. Thus, both the level and the kind of federal research funding are problematic.

---

6 The related concern of grade inflation has garnered more attention.

7 The programs carry with them a variety of conditions and requirements that complicate and often distort the funding of university research.

The distortions imposed by direct-cost only research funding, together with the benefit spillovers from research, make a strong case for more comprehensive federal research support. Research is a major function of Canadian universities, and gains would result from the federal government contributing significantly — at a level corresponding to the associated national benefits — to the full costs of academic research. As an illustration, let me suggest that, in support of research, the federal government contribute an overall 25 percent toward the operating costs of Canadian universities.[8] Added to existing funding, this amount might move us halfway toward closing the funding gap with major public universities in the United States, judging from Davenport's figures.[9] More senior readers will recognize that this proposal resembles the old Established Programs Financing (EPF) program that existed when the federal and provincial governments shared university costs roughly 50–50. To avoid one of the major problems contributing to the demise of that program, the funding could be capped so that provinces would, at the margin, be spending entirely their own money on university research.

This additional federal funding for universities is not intended as relief to the provinces. It should be conditional on the provinces maintaining their own support to universities. The intention is, rather, to upgrade Canadian universities, making them better and more competitive, especially in research.[10] Doing so would make our

8 Based on fiscal year 1998/99 figures, 25 percent would amount to $3.15 billion. Including existing federal research funding in that 25 percent would reduce the additional outlay to $1.85 billion. The 25 percent share is smaller than the one-third share that is implied by Allen's (1999) view that about two-thirds of university costs are for teaching (including graduate instruction).

9 The federal government, through the tax system, is a major beneficiary of the productivity and income increases resulting from university education. This fiscal spillover is another reason for enhanced federal support to university education but it is an argument not pursued here.

10 The added federal funds would not go entirely, or even necessarily, mostly, to research in the narrow sense. In part, the funds are to compensate universities for the research that they are doing already and to help strike a better balance between research and other activities. Thus, some of the funds could be expected to be spent on hiring faculty, a move that, while adding to universities' capacity to do research, would also help to improve the student-faculty ratio. Part of the funding would also go to indirect research costs.

universities better able to contribute to society both through the undertaking of research and through the preparation of Canadians for the knowledge economy. A federal contribution such as I describe here could also address other concerns among those Davenport mentions.

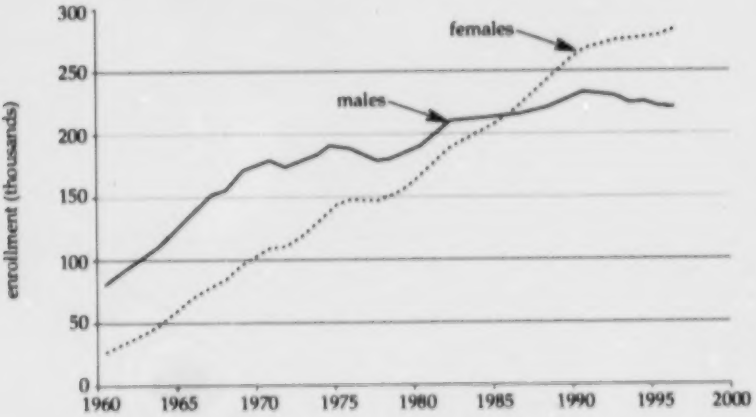
Davenport mentions the difficulties for universities that result from the failure of the federal government to finance the indirect costs of research that are associated with its direct research grants. I am sure that he and many others were delighted by the December 2001 federal budget's provision of $200 million to partially fund those costs. Even if only at half the normal rate and committed for only one year, the initiative is a breakthrough. While the amount is a helpful step, at 1.6 percent of university operating budgets it is a small but notable contribution toward solving the significant problems confronting Canadian universities. Their pressing concerns have developed over a generation, so quick solutions are unlikely. However, we are more likely to resolve them eventually if we establish and follow a comprehensive plan for the federal government to support a significant portion of all university research costs.

Davenport's essay relates to the production processes of universities. As a final comment, I suggest that we study their production methods more intensively in the hope of improving on our techniques and resource utilization — that is, on efforts to become more effective in getting output out of the "barn." Although plagued by measurement problems, investigation of the production processes in units of higher education have attracted considerable attention in both the United Kingdom and the United States (see, for example, Izadi et al. 2002; and Koshal and Koshal 1999) while Canadians have only scratched the surface.

Stephen Easton on Enrollments and the Male/Female Balance

Easton looks at the dramatic increases in female university enrollment in Canada, particularly relative to male enrollment, and seeks an explanation. Not finding answers in the changes to part-time enrollments or to college enrollments, he explores causes of changes

Figure 1: ***Full-Time Undergraduate Enrollment in Canadian Universities, 1960–98***



Sources: Statistics Canada, cat. 81-568, 1978; idem, cat. 81-229, various issues.

in the demand for university education and in the supply of potential students. Changes over time in the relative earnings premiums that a university education provides for women and men appear to be important determinants of the female-to-male undergraduates ratio. Shifts in the ratio of female and male high school graduates — the supply of potential students — have had an ambiguous impact, but Easton sees high school grading practices as contributing to university enrollment patterns.

Because some of Easton's analysis extends back to the early 1970s but the data presented only goes back to 1987, it is useful to look at the enrollment data for an extended period, even if only for emphasis. Figure 1 shows male and female undergraduate enrollments since 1960. In that year, the proportion of female undergraduates broke out of the 21-to-23.5 percent range that it had occupied for 35 years. The relatively steady growth in female enrollments thereafter, getting stronger after 1970 and reaching 56 percent in 1998, is obvious.

Part-time enrollments have diminished since the early 1990s. While it is true, as Easton argues, that males have not shifted from

full- to part-time studies, because of the disproportionate number of women in part-time studies (1.6 females for each male), the move of more students generally to full-time studies reinforces the growing share of full-time university undergraduates who are women. If all of the 50,000-student decline in part-time enrollments that Easton notes occurred between 1987 and 1997 represented a shift to full-time studies, it would have contributed almost 31,000 of the 73,000-student increase in the full-time enrollments of women over that period. In fact, the decline in the number of males enrolled in part-time studies (19,000) exceeded the increase in the number of males enrolled full-time (14,000). Nonetheless, the decline in part-time enrollment should not be dismissed, because it could account for about one-sixth of the 0.23 increase in the female-to-male ratio — from 0.97 to 1.20 — noted. But this is a minor point.

At the heart of Easton's paper are the regressions in his Table 4. Those regressions seek to explain the (log of the) ratio of female-to-male undergraduate enrollments using variables of demand for university education and supply of potential students.

Consider the demand variables first. The demand for university education is expected to increase as the labor income reward for a university degree increases. That reward is defined as the amount by which the earnings of a university-educated person exceed the earnings of one who only went to high school — that is, the university earnings premium. Women are expected to respond to the premium for women, and so to affect the numerator of the dependent variable, and men to the premium for men, affecting the denominator of the dependent variable. The higher-education premiums for women and men are calculated using the results of regressions from Beaudry and Green (1997), who estimate real weekly earnings-age profiles for birth cohorts for women and men, both university and high school educated.

The variable for supply of students is the (log of the) ratio of lagged female high school graduates to male high school graduates (as approximated).

The regression results are strikingly strong, even though the coefficient for the supply ratio is not significantly different from zero once the correction for autocorrelation is imposed. The two

demand variables, however, are quite robust, and the R^2 value is high at 0.99. Easton states that a 10 percent increase in the female education premium generates a 7.6 percent increase in the female-to-male enrollment ratio. A 10 percent increase in men's education premium generates a 10 percent fall in the enrollment ratio — that is, leads to an 11 percent increase in male enrollment if female enrollment is unaffected.

Easton's results are so good as to be somewhat puzzling; in addition, some of his data appear to need reconciliation with other data. Riddell and Sweetman (2000), who also study earnings and education, report education premiums for male and female Canadian workers in 1970, 1980, and 1990. They find that, typically, women holding bachelor's degrees have earned 1.5 to 2.0 times the earnings of high-school-educated women of the same age. Men's education premium has been consistently lower, typically about 1.5 or somewhat less.[11] A more interesting point in this context is that the education premium has been steady (for those ages 21 to 30) or declining (for those ages 31 to 40 and 41 to 50) over the decades from 1970 to 1990, for both men and women.[12] This downward trend in the education premium is consistent with the growing proportion of university educated workers in the labor market. However, the decline in the premium for women over time is not consistent with the positive response Easton finds in the female-to-

11 These values are for full-time, full-year employment. See Riddell and Sweetman (2000), table 7 and figure 3. Allen (1999) also provides age-earnings profiles, but for 1995 only. The high economic rewards that women realize from obtaining a university education are also reflected in rate-of-return studies. For 1985, Vaillancourt (1995) reports private rates of return for bachelor's degrees as being 8.3 percent for men and 18.8 percent for women. Subsequent work reported in this volume for 1990 and 1995 suggests that the differential has narrowed to 2 or 3 percent, as a result of increases in the estimated rates of return to university education for men. Allen (1999) also estimates rates of return, but only social, not private, ones. His results are quite comparable to the 11 percent social rates estimated by Vaillancourt and Bourdeau-Primeau for 1995 for bachelor's degrees. For graduate education, Allen's estimates are notably higher than theirs.

12 Although not without exception, the declines have been absolute as well as relative.

male enrollment ratio. That is, the education premium for women, while large, has been steady or declining, while more women have been going to university and women have been becoming a larger share of the undergraduate student population. One suspects that Easton's data (unlike Riddell and Sweetman's) must show a rising education premium for women to have the positive association with a rising enrollment share.[13]

The actual education premiums that Easton uses as data for his regressions and their time patterns are not obvious. He plots indexes of men's and women's — weekly, I believe — wages for university and high school education in his Figure 6. That figure shows the wages of university-educated women rising while those of high-school-educated women decline. This figure suggests that the education premium is widening, as required for Easton's econometric results, but I am uncertain whether or not the premium can be determined from the relative positions of the two lines; are they consistently scaled? In contrast, the figure shows the real wages of university-educated men declining over time, but those of high-school-trained men declining even faster.

If Riddell and Sweetman (2000), using census data, show education premiums for women of a specific age declining or remaining steady over time (like men's), how does Easton obtain a growing education premium for women? Turning to Beaudry and Green (1997), from which Easton obtains the wage regressions used to calculate age-earnings profiles and education premiums, one notes that, for university-educated females the (year of birth) cohort intercepts of the age-earnings profiles drop — although the decline for females is less than that for males, and, unlike the men's, those declines are offset by increases in the slope of the profiles over time. In other words, there has been an increase in the returns to experience in the labor market for women. In addition, Beaudry and Green's estimates of the gains to women from experience are largest for the most recent entrants; that is, they find "very large age slopes for the

13 It is assumed that controlling for the male premium controls male enrollments and that there is no significant interrelationship between male premiums and female enrollment or vice versa.

most recent cohorts." They go on to note, "since the high earnings levels predicted for the most recent cohorts later in life correspond to age ranges that are well out of sample, such extrapolation should be interpreted with caution" (p. 17). I am speculating here, but I suspect that it is the relatively large predicted gains to experience for women, and especially those for the latest labor market entrants, that provides the education premiums that are driving the results for women in Easton's model. The smoothly growing estimates of the education premium for women that are suggested by Easton's Figure 6 and that might be implied by his use of the Beaudry and Green results, in combination with the steady growth of the female-to-male enrollment ratio, could generate the kind of excellent fit and significant coefficient he finds. It would have been interesting and informative if Easton had reported the education premium data used for his estimates and compared them to the data of other observers such as Riddell and Sweetman.

A growing share of Canada's young women is attending university. The enrollment rate — undergraduate women as a percentage of 18-to-24-year-old women — began to increase in the 1970s, and doubled between 1980 and 1995 (from 9 to 19 percent).[14] This dramatic growth occurred during a period in which there was a hefty education premium for women, but also one in which that premium seems to have been compressed. Growth in female university enrollment during a period in which the education premium has diminished somewhat is at odds with Easton's model. While I have no doubt that the economic rewards for university education, and changes in those rewards, do influence people's decisions to pursue higher education, I also believe that there are more factors determining the growth, and the relative growth, in female university enrollment. That is, I suspect that a variety of factors have caused women to respond more to the continuing large education premiums in recent years than they did in the past. That the growing share of women in universities began in the 1960s, just as effective contraception became widely available to them, is not a coinci-

14 The male enrollment rate declined during the 1970s, rose slowly during the 1980s, and leveled off in the 1990s. See Riddell and Sweetman (2000).

dence. Changes in divorce laws, trends in marriage and family size, and new child-rearing patterns, including the increased availability of day care (and changes to the tax treatment of child care costs), all of which have extended women's projected work force lives, have probably had an impact on the numbers of women who choose university. Broad changes in social attitudes toward women both in the home and in the workplace have also contributed. The stagnating returns to male earners, partly the result of a growing labor force, may have induced still more women into both the labor market and universities. These are only some suggestions of other contributing factors; readers can add their own.

In short, a broad range of social and economic factors, often interrelated, has contributed to the growth of the share of women attending universities in Canada. These factors are overlooked in Easton's analysis, which singles out the education premium and, I suspect, attributes to this factor too strong an explanatory power. I have already suggested checking the education premium data as one cautious response to Easton's statement. Another alternative would be attempting to explain female and male enrollment separately — that is, estimating two equations and, ideally, trying to include variables reflecting some of the other possible factors contributing to the trends in women's employment and education decisions. Combining economic and social forces acting on education decisions could provide a much more powerful explanation and offer even more interesting insights.

Easton also points out that the high school graduation grading system may be affecting the relative supplies of female and male university students. In British Columbia, final high school grades are a combination of the provincial exam grade and a school-based assessment. On average, females consistently perform better than males in the school-based assessments, unlike in the exam performance. Easton speculates that moves to include school-based assessments may contribute to the increasing portion of women in universities. That may be so, but, after allowing for an adjustment period, it should only cause a one-time shift, unless there is a progressive expansion of the weight given to school-based assessments. It would be interesting to investigate whether or not the inclusion of school-based grades better predicts university performance.

Alice Nakamura and Joel Bruneau on e-Recruiting

Most readers will find the Nakamura and Bruneau paper an eye-opening update on the recruiting of university graduates. Many of us, including those on staff in the universities, have not kept fully abreast of how this process has evolved. E-recruiting has created a cost-effective national, even international, recruiting system overlayering the university placement offices, which continue to exist like islands in an archipelago. E-recruiting is expanding the amount and kind of information available, broadening search horizons, speeding the process, and lowering the costs of recruiting on both sides of the market. It has the potential to enhance job market performance, but the incentives facing campus placement offices and the market dominance (partly by US-owned firms) in the e-recruiting industry is hampering the realization of those gains for Canadians. Organizations that should be working together for the benefit of our university graduates and employers are at odds. This lack of cooperation frustrates especially the efforts of CareerOwl, a small player (of which Alice Nakamura is a founder) in the e-recruiting world, despite the advantages it offers especially to smaller employers.

E-recruiting does not replace traditional recruiting methods, according to Nakamura and Bruneau, but supplements them. While some aspects of that role are clear enough from their analysis, it would be informative if we had been told more about the place that e-recruiting now occupies in the larger recruiting picture, especially with regard to new university graduates. How quickly has it evolved? What kinds of employees recruited by this method? What portion of those jobs appear on the Internet? To what extent do employers use e-recruiting exclusively? How extensively do new graduates rely on it? For what share of placements made is e-recruiting responsible? Are campus recruiting offices becoming less relevant in the placement of new graduates, or is their role in the process still as important, but changing?

This kind of basic information is missing from Nakamura and Bruneau's paper. Perhaps it is not readily available. An article in a human resources magazine reports that "almost half of Fortune Global 500 companies actively recruit on the Internet," that a survey

of Workopolis.com users shows that 69 percent applied for a job listed on the site, that 40 percent of applicants were contacted for an interview, and that 94 percent of college graduates use corporate websites to gather information on potential employers (Altass 2001). Warburton and Warburton (2001), reporting on a British Columbia government experience in e-recruiting, state that, at the time of the search they studied, Monster.ca had more than 200,000 registered job seekers, CareerMosaic had 90,000, and CareerOwl 40,000. (Currently, CareerOwl has 59,000, a fact that demonstrates the rapid growth of e-recruiting.)

The Warburtons' report is positive on the subject of e-recruiting; they also briefly review several alternatives that were considered. Monster and CareerMosaic are branches of large US operations; those two and CareerOwl offered the lowest costs for posting positions, well below the rates of the two large Canadian commercial e-recruiters, Workopolis and CareerClick. Among the three used in that search, CareerOwl stood out in terms of low cost, convenience, affordable options, technical quality, and search categories. The job seekers listed there came primarily from the major English-speaking Canadian universities. Despite its current small size, CareerOwl appears to be a credible player in the e-recruiting marketplace.

The difficulties facing CareerOwl, despite the advantages it offers, appear to result from its being a small player, and from competition in e-recruiting with university placement services. The glib and simplistic response to this situation is "welcome to the market." Real markets are not perfect; there is not perfect information, and the outcomes are not necessarily fair. In some ways, e-recruiting resembles the world of Microsoft and operating systems; the dominant service may not be the best or have the most desirable features, but it is very hard for customers to avoid using it. The result is a difficult market for minor competitors.

The more serious and thoughtful response to this situation is that there is evidence that market imperfection is limiting the potential of e-recruiting in Canada and tilting the playing field against Canadian employers, especially small ones, as Nakamura and Bruneau argue. That US e-recruiters could be dominating the market (we do not know whether or to what extent this is the case) and exposing Canadian job seekers to US employers is not, in itself,

the issue. This exposure to a broader range of potential employers expands the job choices available to Canadian graduates. A problem arises if Canadian employers — and, in turn, potential employees — are not well served by the available options, or have difficulty gaining access to them — or if pure market power squeezes Canadian based e-recruiters out of the marketplace altogether.

There would be advantages for university placement services in linking with national and international e-recruiters. E-recruiters also can gain from such links, especially if an individual operation can dominate a university's connections. Favored-party arrangements can be expected to develop. One could speculate that these arrangements might take the form of exclusive marketing deals, similar to those that soft-drink manufacturers have been offering universities. Such incentives will look good to resource-short, self-funded campus career offices, but the limitations they would place on choice might be problematic. Limited choice in soft drinks on campus is one thing; limited choice (or even preferential direction) in job placement services is another. The exclusivity or preferences of "Coca-Cola"-type arrangements could work to the disadvantage of graduates, employers, and the country. By instituting inappropriate incentives, being slow to respond to the revolution in recruiting by creating guidelines, and failing to consider the long-run consequences of self-financing placement offices, universities may easily lead themselves, and all of us, into a less than desirable outcome.

Markets work most effectively in a context of competition and information. Students and employers should be aware of the full range of e-recruiting options. University placement offices are more likely to be serving both their constituents (students) and employers well if they inform them about and link them to the whole spectrum of e-recruiters. Current incentives do not push in this direction, however.

Unfortunately, Nakamura and Bruneau do not offer — at least in the original draft of the paper — explicit recommendations for modifying those incentives. Universities might reconsider whether or not the existing arrangements with their placement offices — including funding and oversight — are, or will be, the best way to serve their students in the e-recruiting world. Governments might

consider their influence as major employers, as e-recruiters (Campusworklink.com), and as market information providers.

Each player in the placement market, whether an e-recruiter or a university placement office, would gain from better linkages. Arrangements to share the charges for services based on the number and type of connections made by users would go some way toward rewarding each recruiter for its contribution and for achieving broad access. Broad access, competition and fair distribution of revenues, however, are not likely to be the common objectives, especially of dominant players. While low-cost e-recruiters may have little revenue to share, the jobs and the additional recruits that they add to the pool can be expected to have value to other market participants. Hence, some concerted action, ideally initiated by the major universities, seems essential if improvements are to be made to the developing market structure.

E-recruiting offers many advantages for the labor market, and it is growing rapidly. It is important that a highly effective, open, and competitive e-recruiting market evolves.[15] For this goal to be realized, it seems that some policy initiative will be required, especially at the university level. In any case, if CareerOwl continues to receive positive reviews such as that of Warburton and Warburton, its prospects for surviving and making an important contribution in the long term are encouraging.

Conclusion

The papers by Davenport, Easton, and Nakamura and Bruneau are individually insightful pieces; collectively, they provide a valuable broad overview of many important issues facing Canadian universities today. The Easton and the Nakamura and Bruneau papers in particular raise more obscure, often neglected matters. Each of the papers is excellent reading: informative and stimulating.

15 Success in the selection of a person's first job is an important determinant of his or her career path. For example, see Finnie in this volume.

References

Allen, Robert C. 1999. "Education and the Technological Revolutions: The Role of the Social Sciences and Humanities in the Knowledge Based Economy." Vancouver: University of British Columbia, Department of Economics. November.

Altass, Angela. 2001. "E-Cruiting: Changing the HR Landscape." *Network* 3 (2): 12–14.

Baudry, Paul, and David Green. 1997. "Cohort Patterns in Canadian Earnings: Assessing the Role of Skill Premia in Inequality Trends." NBER Working Paper 6132. Cambridge, Mass.: National Bureau of Economic Research. (Also published in 2000 in *Canadian Journal of Economics* 33 (4): 907–936.)

Izadi, Hooshang, et al. 2002. "Stochastic Frontier Estimation of a CES Cost Function: The Case of Higher Education in Britain." *Economics of Education Review* 21: 63–71.

Koshal, Rajindar, and Manjulika Koshal. 1999. "Economies of Scale and Scope in Higher Education: A Case of Comprehensive Universities." *Economics of Education Review* 18: 269–277.

Jennings, Phillip. 1998. "School Enrolment and the Declining Youth Participation Rate." *Policy Options* 19 (3): 10–14.

Litten, Larry H. 1984. *Issues in Pricing Undergraduate Education*. San Francisco: Jossey-Bass.

Riddell, W. Craig, and Arthur Sweetman. 2000. "Human Capital Formation in a Period of Rapid Change." In W. Craig Riddell and France St-Hillaire, eds., *Adapting Public Policy to a Labour Market in Transition*. Montreal: Institute for Research on Public Policy.

Smith, Stuart L. 1991. *Report of the Commission of Inquiry on Canadian University Education*. Ottawa: Association of Universities and Colleges of Canada.

Stager, D.A.A. 1989. *Focus on Fees: Alterative Policies for University Tuition Fees*. Toronto: Council of Ontario Universities.

Statistics Canada. 1978. *Historical Compendium of Educational Statistics from Confederation to 1975*. Cat. 81-568.

———. Various years. *Education in Canada*. Cat. 81-229.

Vaillancourt, François. 1995. "The Private and Total Returns to Education in Canada, 1985." *Canadian Journal of Economics* 28 (3): 532–554.

Warburton, Rebecca, and William Warburton. 2001. "Canadian-Made E-Solution Proves Cheap and Effective." *Canadian Business Economics* 8 (3): 37–39.

Quantity or Quality?
Research at Canadian Universities

John Chant and
William Gibson

Universities provide many different services to their students. The most obvious one is the transfer of knowledge through classroom teaching. Universities also filter, or sort, their students according to their abilities. But these roles alone would make institutions of higher learning little more than extensions of primary and secondary schools. Recent approaches to higher education focus on another important function of universities: providing their students with signals. Some of these signals relate to individual students — for example, indications of their performance relative to other students through grades or personal recommendations from professors. Others are collective signals based on a university's overall reputation. A degree from a particular university tells the outside world that the student has met that institution's standards. These collective signals may be shaped by many factors, such as the historical performance of alumni and the grandeur of a university's campus. But one crucial component in the signal sent by a university's reputation is the research performance of its academic staff.

In this essay, we examine the research performance in science and social science of top Canadian universities relative to those in the United States. We believe this is important for several reasons.

The authors thank Steve Easton, Jack Knetsch, David Laidler, John Polanyi, and Jeff Smith for their helpful comments, and Elizabeth d'Anjou for her superb editing.

Some argue that a professor's research contributes to his or her effectiveness as a classroom teacher.[1] It also makes a contribution to our collective knowledge and, for that reason, benefits society. Without discounting these arguments, we emphasize the positive impact research has on a university's reputation and hence on the signals it sends. Even undergraduate and professional students benefit from research if it enhances the reputation of a university in the minds of the general public, especially employers. For high school students selecting a university to attend, for graduates choosing a graduate school, or for employers evaluating résumés, reputations are important substitutes for first-hand experience.

We believe that the research performance of Canadian universities matters. Strong performance will enhance their reputation for quality and benefit Canadian students, whether they seek employment or continue their studies after graduation, in or outside Canada. Employers will pay more to hire students from universities that are prominent and well-known for their research. Similarly, top graduate and professional schools are selective with respect to the institutions from which they draw their students. And an enhanced reputation for a graduate school leads to a larger applicant pool, allowing the university to be more selective in its admissions. This perceived increased difficulty of entry, in turn, serves to enhance the university's reputation further in the eyes of the public.

This paper is organized as follows. We begin by describing the data we use to analyze the comparative research performance of Canadian and US universities. In the second section, we compare the recent research performances of Canadian and US universities in 21 disciplines. In the third section, we examine trends in relative performance from the early 1980s to the present. We then shift our attention away from individual disciplines to the overall performance of universities. Finally, we conclude with some reflections on the significance of our results.

1 While we accept the validity of this view, we would not push it very far. It must deal with the evidence that there is an inverse relation among professors between their effectiveness as researchers and the amount of their time devoted to teaching undergraduates. The argument appears more valid at the graduate level.

Indicators of Research Performance

In this study, we use the two data sets collected by the Institute for Scientific Information (ISI) that are based on their well-known citation indexes.[2] These data sets provide information on both the number of papers published and the citations these papers received in more than 23 disciplines for a broad sample of Canadian and US universities over the 1981–98 period (see Tables A-1 and A-2 in the Appendix). The data sets we used do not include information for the arts and humanities. They are based on papers published and citations received in some 5,500 journals in science and 1,800 in the social sciences. The Canadian and US data sets differed somewhat in their coverage. The 111 universities included in the US data set consist primarily of research universities. In contrast, the 67 universities in the Canadian set include many institutions that emphasize teaching.[3]

We use two parts of the data collected by ISI: the number of papers and the number of citations per paper — the "paper impact" — identified with a particular discipline at the universities that we study. The number of papers, in our view, is a measure of research *quantity*, or the level of research activity at an institution. The paper impact measures the recognition that the research gains from other scholars on a paper-by-paper basis, which to us is a measure of research *quality*.

Although we believe that both the number of papers and paper impact contribute to the value of a university's overall reputation, we do not know the relative contribution of each. Moreover, each measure has shortcomings. Clearly, the size of an institution will be a major factor contributing to the number of papers identified with it. Although we lack the information to correct for size, we do discuss

2 The Canadian data have been analyzed in two *Science Watch* papers (1992; 1995), and summarized by Strauss (1995).

3 Only 17 of the US institutions published fewer than 10,000 papers and none had fewer than 1,000. In contrast, 48 Canadian institutions (almost 70 percent of them) published fewer than 10,000 papers. Of these, 7 published fewer than 100 papers.

how university size relates to our results.[4] Similarly, the paper impact measure treats all citations to a paper equally regardless of whether they occur in well-regarded or lesser journals, and whether they are laudatory or critical. Although these considerations may be important in judging the impact of any particular paper, we believe they will be less significant when examining the impact of a university's papers over an entire discipline in the longer term. A premium citation will beget further citations. Over time, therefore, the "quality" of citations will be captured by the number.

We used only 21 of the 23 fields surveyed by ISI in our study. In most fields, national differences in research content are unlikely to make much difference, but we chose not to use law because it is the field most likely to feature work that is specific to the country in which the research takes place. Articles on Canadian law topics are less likely to be cited by US scholars than articles by their compatriots. Given the relative size of the two countries, comparisons of article impact in this field would not be an adequate measure of research quality. We also did not consider the field ISI calls "other social sciences" because it is not clear that the content of this category is comparable across institutions.

The fields covered in our study differ substantially with respect to the number of papers published, the number of per paper citations, and the distribution of these, as shown in Table 1. The number of papers identified with the top-ranked university over the 1994–98 period in a particular discipline ranged from a low of 215 for education to a high of more than 15,000 for clinical medicine. Similarly, the citations per paper identified with the top-ranked university ranged from more than 39 for molecular biology to just 3.1 for engineering. In addition, the differences among institutions varied across disciplines. In two disciplines, the second-ranked institution published fewer than half as many papers as the top-ranked institution; in some other disciplines, more than 20 institu-

4 To correct for size, we would need the number of researchers in each discipline at each institution. Such a measure would be complicated by the fact that many of the disciplines do not correspond closely to one or even several well-identified departments. For example, one institution that ranks in the top ten in physics does not actually have a department in that discipline.

Table 1: ***Maximum Citation Rates and Number of Papers Published, by Discipline, Canadian and US Universities, 1994–98***

Discipline	Maximum No. of Citations per Paper	Rank of Institution with 50% of Maximum Citation Rate	Maximum No. of Papers Published	Rank of Institution Publishing 50% of Maximum No. of Papers
Agricultural sciences	8.3	8	834	15
Astrophysics	13.5	38	1,810	3
Biology and biochemistry	16.4	38	4,577	2
Chemistry	10.1	48	2,471	14
Clinical medicine	9.4	49	15,056	4
Computer science	3.2	33	305	22
Ecology and environment	6.0	50	809	14
Economics	4.7	30	980	12
Education	3.2	38	215	18
Engineering	3.1	42	2,326	13
Geosciences	8.7	31	1,364	8
Immunology	22.9	20	1,733	1[a]
Mathematics	3.3	26	597	23
Materials sciences	6.6	13	838	12
Microbiology	21.9	22	842	10
Molecular biology	39.1	19	3,252	1[a]
Neurosciences	13.4	44	2,560	11
Pharmacology	11.5	22	528	24
Physics	9.2	47	3,821	12
Plant and animal sciences	6.7	22	2,941	9
Psychology	7.1	44	1,732	7
Maximum	*39.1*	*50*	*15,056*	*23*
Minimum	*3.1*	*8*	*215*	*1*

[a] The second-ranked institution published fewer than half the number of papers of the first-ranked institution.

Sources: Institute for Scientific Information 1981–98a; 1981–98b.

tions published at least half that number of papers. Differences in the patterns of citations per paper were less pronounced; in every case, at least eight institutions gained half the citation rate of the leading institution, and in one case more than 50 institutions received at least that many citations.

These differences in patterns served to limit the types of comparisons among disciplines that we could make in this study. Comparing institutions by total papers or by citations per paper over all fields would not be meaningful. An institution specializing in clinical medicine might appear to be much more productive than one specializing in mathematics; in fact, the differences would arise almost entirely from the differences among fields. Similarly, a university with a concentration of strength in economics — in which the maximum per paper citation rate at any institution was 4.7 — would appear to have lower-quality research than a university that concentrated on microbiology, where even the twentieth-ranked institution received more than ten citations per paper published. For these reasons, we do not present any university-by-university measures with respect to total papers published or average citations rates to papers published.

We also took discipline differences into account in setting our standards for comparing Canadian and US institutions. The more comprehensive coverage of Canadian universities in our sample raises problems for comparing the number of citations. If, in some fields, Canadian institutions that have relatively little research output nevertheless gain high citation rates, the overall performance of Canadian institutions would be overstated for these fields. Moreover, it is not clear that a high citation rate for a very small number of articles contributes significantly to the reputation of an institution. To overcome this problem, we introduced thresholds for including institutions in the comparisons of article impact. In all cases, we included the top 50 institutions in the combined Canadian-US sample to ensure a broad representation. We also added institutions beyond the fiftieth ranking when necessary to include all institutions that accounted for publications at a level of at least 20 percent of the institution with the most publications in the discipline. The purpose of this second dimension of the threshold was to ensure that small differences among institutions with respect to

papers published did not skew the results with respect to either papers published or paper impact.

Research Performance, 1994–98

By what standards should the research performance of Canadian universities be judged relative to their US counterparts? Both countries have many universities with different missions that cater to different groups of students. In focusing our attention on the top performers with respect to research in both countries, we have used the "rule of ten," a common yardstick for quantitative comparisons between Canada and the United States. If the distribution of Canadian universities by their research performance were comparable to that of US universities, in the combined sample one Canadian university would be expected in the top ten and the top three Canadian universities overall could be expected to fall between tenth and twentieth. While this expectation (based on the fact that the United States' population is about ten times Canada's) is clearly a rough-and-ready standard, we believe it provides a good starting point.

The Quantity of Papers

Canadian research measures up quite well with respect to the number of papers published by discipline, as Table 2 shows. The leading Canadian institution was ranked in the top ten for 12 of the 21 disciplines considered. In only two fields (economics and physics) did the top-ranked Canadian institution fall outside the top 20 from the combined sample. The top ranking in Canada for the number of papers published was, for all disciplines, one of just five institutions — Toronto, Guelph, McGill, the University of British Columbia (UBC), and Waterloo — with Toronto accounting for the top Canadian ranking in 15 fields. The performance of the top three Canadian institutions in the various disciplines also meets the expectations of our "rule of ten" yardstick: the average of the top three ranks came in between tenth and twentieth in 12 of the disciplines.

Table 2: ***Relative Performance of Canadian Universities, by Number of Papers Published, 1994–98***

Discipline	Number of Papers Published		Rank by Number of Papers Published	
	Average of Top 3 Canadian Universities	Average of Top 3 Canadian and US Universities	Average of Top 3 Canadian Universities	Top-Ranked Canadian University
Agricultural sciences	418	729	16	7
Astrophysics	230	1,342	33	18
Biology and biochemistry	1,775	3,084[a]	13	3
Chemistry	1,209	1,972	17	10
Clinical medicine	6,182	10,985[a]	13	2
Computer science	185	290	16	8
Ecology/environment	400	677	17	12
Economics	271	771	34	22
Education	118	192	16	5
Engineering	943	2,124	21	15
Geosciences	511	1,127	21	19
Immunology	405	1,105	30	7
Materials sciences	388	717	15	8
Mathematics	326	566	19	14
Microbiology	342	680	21	14
Molecular biology	1,046	2,056	13	4
Neurosciences	1,349	2,061	12	4
Pharmacology	423	505[a]	7	2
Physics	1,313	3,495	29	28
Plant and animal sciences	1,226	3,281	17	8
Psychology/psychiatry	886	1,458[a]	42	3

[a] A Canadian institution is included in the top three.

Source: Table A-3 of this paper.

Quality of Papers

The research performance of Canadian universities, as shown in Table 3, is weaker with respect to its impact on, or recognition from, other scholars than it is with respect to the number of papers published, according to our measures. In only three disciplines (astrophysics, education, and materials sciences) did the rate of citations per paper of the top-ranked Canadian institution fall within the top ten of the combined Canadian-US sample. Moreover, the top-ranked Canadian institution in 12 of the disciplines failed to rank within the top 20 institutions in the combined group.

The top rankings for citations per paper within a discipline were less highly concentrated than those for total number of papers. Ten different institutions received the top ranking in Canada for one or more fields. While the University of Toronto received the largest number of first rankings, it earned only seven top rankings for paper impact, compared with its 15 with respect to the number of papers published.

Canada's lower success rate with respect to paper impact, or quality, is also seen in the average ranking of the top three Canadian institutions. In only four disciplines (agricultural sciences, astrophysics, materials sciences, and plant and animal sciences) did the average rank of the top three meet our yardstick of falling within the top 20, and in three it was not even within the top 40.

Conclusions

Overall, it appears that the research performance of Canadian universities is better with respect to the quantity of papers they produce than to the impact those papers have. Although Canadian universities hold their own alongside their US counterparts in the number of papers published, they rank well below the top US universities in the recognition their research receives from their peers.

Our results with respect to paper impact could be challenged on the grounds that some research is of interest primarily to Canadians and is therefore unlikely to be cited heavily by researchers outside Canada. As mentioned earlier, we left out law out of our

Table 3: ***Relative Performance of Canadian Universities, by Citation Rate, 1994–98***

Discipline	Average Number of Citations per Paper		Rank by Number of Citations per Paper	
	Average of Top 3 Canadian Universities	Average of Top 3 Canadian and US Universities	Average of Top 3 Canadian Universities	Top-Ranked Canadian University
Agricultural sciences	2.8	4.6	13	10
Astrophysics	9.3	12.8	17	7
Biology and biochemistry	8.6	16.7	37	31
Chemistry	5.7	9.5	42	29
Clinical medicine	6.3	9.2	36	32
Computer science	1.3	2.5	38	47
Ecology/environment	4.6	6.0	22	13
Economics and business	1.8	4.3	42	37
Education	2.0	2.6[a]	24	1
Engineering	1.8	3.1	36	28
Geosciences	4.0	8.7	39	37
Immunology	10.9	25.4	25	18
Materials sciences	3.1	6.8	19	8
Mathematics	1.6	3.2	37	27
Microbiology	6.5	17.5	54	48
Molecular biology	14.0	35.4	36	28
Neurosciences	8.1	17.5	35	31
Pharmacology	6.5	11.6	25	20
Physics	6.3	11.8	31	19
Plant and animal sciences	3.6	6.2	19	13
Psychology/psychiatry	3.9	7.4	37	28

[a] A Canadian institution is included in the top three.

Source: Table A-4 of this paper.

list of disciplines on the assumption that it was likely to be particularly country-specific. To varying degrees, national cultural differences may affect the citation rates of papers in some other disciplines as well. Of the disciplines in our study, those where the peculiarities of Canadian research seem likely to be the greatest include agricultural sciences, economics, and plant and animal sciences. It is less likely that there would be a distinctly Canadian approach to such fields as astrophysics, mathematics, neuroscience, or physics. As Table 3 shows, however, Canadian institutions' performance in those fields displays no relationship between the expected degree of a field's specificity to Canada and its rank in terms of paper impact. The top three Canadian institutions in the fields most relevant to Canada have an average rank of fourteenth, nineteenth, and forty-second (the average across all fields is thirty-second). Of the four fields in which the Canadian top three did worse than fortieth, only one, economics, seems likely to be specific to Canada to some degree.

Performance Over Time

The fact that the ISI data set extends over nearly two decades allows us to examine, to some extent, how Canadian universities' research performance has changed over time. Once again we look at both the number of papers (quantity) and the rate at which they are cited (quality).

Changes in Papers

Table 4 shows how the relative performance of Canadian universities has changed with respect to the number of papers published by disciplines across four periods: 1981–85, 1984–88, 1989–93, and 1994–98.[5] Panel A gives the position of the top-ranked Canadian university in the overall sample for each discipline in each period;

5 The table compares four five-year periods for the 19 years of the data set. This period necessitates some overlap of periods for five-year comparisons. We chose to overlap the first two periods.

Table 4: ***Changes in Rankings of Canadian Universities, by Number of Papers Published, 1981–98***

Discipline	Rank				Change Relative to 1994–98		
	1981–85	1984–88	1989–93	1994–98	1981–85	1984–88	1989–93
A. Position of Top-Ranked Canadian University							
Ecology/environment	23	17	18	12	–11	–5	–6
Mathematics	25	19	20	14	–11	–5	–6
Education	15	9	6	5	–10	–4	–1
Molecular biology	14	6	5	4	–10	–2	–1
Agricultural sciences	16	14	8	7	–9	–7	–1
Economics	29	26	28	22	–7	–4	–6
Materials sciences	14	12	14	8	–6	–4	–6
Biology and biochemistry	8	6	5	3	–5	–3	–2
Immunology	10	7	9	7	–3	0	–2
Astrophysics	21	17	14	18	–3	+1	+4
Clinical medicine	4	4	2	2	–2	–2	0
Psychology	4	3	3	3	–1	0	0
Chemistry	11	13	12	10	–1	–3	–2
Neurosciences	4	3	4	4	0	+1	0
Engineering	14	17	18	15	+1	–2	–3
Microbiology	13	16	23	14	+1	–2	–9
Pharmacology	1	1	1	2	+1	+1	+1
Plant and animal sciences	5	5	5	8	+3	+3	+3
Computer science	5	8	18	8	+3	0	–10
Geosciences	12	9	12	19	+7	+10	+7
Physics	19	22	18	28	+9	+6	+10
Average	12.7	11.1	11.6	10.1	–2.6	–1.0	–1.4

Source: Table A-5 of this paper.

Table 4 - continued

Discipline	Rank				Change Relative to 1994–98		
	1981–85	1984–88	1989–93	1994–98	1981–85	1984–88	1989–93
B. Average Position of Top Three Canadian Universities							
Molecular biology	27	18	18	13	–14	–5	–5
Agricultural sciences	27	23	17	16	–11	–7	–1
Ecology/environment	28	24	21	17	–11	–7	–4
Clinical medicine	23	20	16	13	–10	–7	–3
Psychology	22	18	17	13	–9	–5	–4
Biology and biochemistry	21	19	17	13	–8	–6	–4
Mathematics	27	24	22	19	–8	–5	–3
Education	23	18	20	16	–7	–2	–4
Immunology	26	25	22	19	–7	–6	–3
Microbiology	27	24	25	21	–6	–3	–4
Pharmacology	13	11	10	7	–6	–4	–3
Neurosciences	14	10	9	12	–2	+2	+3
Materials sciences	16	17	19	15	–1	–2	–4
Astrophysics	33	28	23	32	–1	+4	+9
Plant and animal sciences	17	16	16	17	0	+1	+1
Engineering	20	22	21	21	+1	–1	0
Chemistry	15	15	21	17	+2	+2	–4
Physics	26	29	23	29	+3	0	+6
Economics	30	28	36	34	+4	+6	–2
Geosciences	17	15	18	21	+4	+6	+3
Computer science	14	20	29	24	+10	+4	–5
Average	22.1	20.2	20.0	18.5	–3.7	–1.7	–1.5

Source: Table A-5 of this paper.

panel B does the same for the average of the top three. Both show an overall improvement in the rankings of Canadian institutions over the period. The average of the first ranks improved between 1981–85 and 1994–98 by more than two places (from 12.7 to 10.1), while the average rank of the top three institutions by discipline improved by more than three places (from 22.1 to 18.5).

This improvement was not, however, uniform over fields. The top rankings improved in 13 of the 21 fields, and the average of the top three rankings improved in 14. In both cases, one field showed no change, but Canadian universities slipped in the ranking in all the other fields.

Changes in Impact

Any analysis of how the rank of the Canadian universities in our sample changed over time with respect to paper impact is more complicated, these rankings can change in a number of ways. The most straightforward situation is when the same institution holds the top rank — or the top three schools hold the top three ranks — across all four time periods. In this case, any change in the ranking reflects changes in the performance of the school (or group of schools). The analysis becomes more complicated when different institutions make up the top group from period to period. When an institution moves up the ranks and replaces one of the previous leaders, changes in the performance of the earlier leaders are tempered by the replacement of one of them by another institution. The most difficult case to analyze is when an institution meets the threshold for inclusion in the sample in one period and fails to meet it in another. In this case, the overall ranking of Canadian institutions in a discipline can change substantially without any significant change in the performance of any institutions in that discipline.[6] Moreover, such a change in ranking can occur as a result

6 For example, consider a discipline where Canadian institutions rank tenth, twentieth, and thirtieth in one period, to average twentieth over the top three. Assume also that, during the period, a Canadian institution that failed to meet the threshold for inclusion with respect to the number of articles published...

of only a minor change in an institution's performance with respect to the threshold criterion.[7]

Table 5 summarizes the changes in the ranking of both the top-ranked Canadian institution (panel A) and the average of the top three (Panel B) with respect to the impact of articles over the same time period used in Table 4. Here, the evidence is mixed. The standing of the top-ranked institutions improved by 0.8 of a place over the period as a whole. Part of this change is, however, accounted for by the inclusion of Simon Fraser University as the top-rated university in education for the final period even though it failed to qualify for inclusion during the 1984–88 and 1989–93 periods. When the analysis is restricted to institutions qualifying in all periods, the average rank of the top-rated institutions deteriorated by 0.8 of a place.

Table 5 also shows that the differences among disciplines with respect to the change in first-ranked Canadian institutions are substantial. The split was quite even: 10 first-ranked institutions moved up and 11 moved down. At the extremes, education and astrophysics each improved by almost 30 places, while the top institution in computing fell by 37 places.

Panel B of the table shows how the average rank in the overall sample of the top three Canadian institutions in each discipline changed. Over the entire period, these rankings slipped on average by more than two places — from 30.1 in the initial period to 32.3 in the final period. The final three columns show that this decline

---

Note 6 - cont'd.

...would have ranked first in terms of impact if it had been included. If, in another period, this institution had qualified and the institutions did not change their rankings, the top three Canadian institutions would have ranked first, tenth, and twentieth, for an an average of tenth. This change would have taken place without the ranking of any Canadian institution changing. The same phenomenon also works in reverse when an institution that had previously met the threshold no longer does so.

7 For example, an institution could be excluded from the impact comparison in one period if it published 49 articles and included the next if it published 50. If it had a high ranking on paper impact, such a change could substantially affect the impact performance of the top-ranking institutions.

Table 5: ***Changes in Rankings of Canadian Universities, by Citations per Paper, 1981–98***

Discipline	Rank				Change Relative to 1994–98		
	1981–85	1984–88	1989–93	1994–98	1981–85	1984–88	1989–93
A. Position of Top-Ranked Canadian University							
Education	29	10	19	1	–28	–9	–18
Astrophysics	34	21	9	7	–27	–14	–2
Physics	39	39	30	19	–20	–20	–11
Materials sciences	23	21	32	8	–15	–13	–24
Biology and biochemistry	44	10	29	31	–13	+21	+2
Immunology	30	13	15	18	–12	+5	+3
Clinical medicine	42	37	39	32	–10	–5	–7
Molecular biology	36	29	17	28	–8	–1	+11
Ecology/environment	20	23	15	13	–7	–10	–2
Chemistry	31	43	54	29	–2	–14	–25
Engineering	19	11	18	20	+1	+9	+2
Plant and animal science	11	6	14	13	+2	+7	–1
Agricultural science	6	5	16	10	+4	+5	–6
Geosciences	32	35	28	37	+5	+2	+9
Psychology	23	30	15	28	+5	–2	+13
Neurosciences	24	37	25	31	+7	–6	+6
Mathematics	19	35	28	27	+8	–8	–1
Pharmacology	6	10	5	20	+14	+10	+15
Microbiology	33	36	37	48	+15	+12	+11
Economics	10	18	31	37	+27	+19	+6
Computer science	10	10	11	47	+37	+37	+38
Average	24.8	22.8	23.2	24.0	—0.8	+1.2	+1.0

Source: Table A-6 of this paper.

Table 5 - continued

Discipline	Rank				Change Relative to 1994–98		
	1981–85	1984–88	1989–93	1994–98	1981–85	1984–88	1989–93
B. Average Position of Top Three Canadian Universities							
Astrophysics	37	34	21	17	–20	–17	–4
Immunology	39	31	24	25	–14	–6	+1
Physics	42	40	38	31	–11	–9	–7
Materials sciences	29	25	38	19	–10	–6	–19
Biology and biochemistry	46	27	39	37	–9	+10	–2
Clinical medicine	44	43	41	36	–8	–7	–5
Ecology/environment	30	27	16	22	–8	–5	+6
Education	35	21	29	29	–6	+8	0
Molecular biology	40	39	34	36	–4	–3	+2
Plant and animal science	17	12	18	19	+2	+7	+1
Chemistry	39	46	60	42	+3	–4	–18
Geosciences	34	36	34	39	+5	+3	+5
Neurology	30	40	33	35	+5	–5	+2
Agricultural sciences	8	13	20	13	+5	0	–7
Mathematics	27	37	30	37	+10	0	+7
Engineering	22	19	21	33	+11	+14	+12
Pharmacology	14	31	25	25	+11	–6	0
Psychology	26	29	28	37	+11	+8	+9
Microbiology	39	47	41	54	+15	+7	+13
Economics	19	20	36	42	+23	+22	+6
Computer science	14	21	23	49	+35	+28	+26
Average	30.0	30.4	30.9	32.2	+2.2	+1.9	+1.3

Source: Table A-6 of this paper.

accelerated over time. Here, too, the situation differed substantially, depending on the discipline. In astrophysics, for example, the average of the three leaders improved by 20 places, while in both economics and computing it slipped by more than 20 places.

A Focus on Institutions

So far, we have analyzed the record of Canadian higher education solely through the accomplishments of Canadian institutions and their scholars on a field-by-field basis. In this section, we shift the to the overall accomplishments of institutions.

At the top tier of US institutions of higher education is a group of universities with brand names recognized throughout the world. This group includes both private universities — Harvard, Yale, Massachusetts Institute of Technology, Princeton, Duke, Chicago, and Stanford, among others — and public universities — such as the University of California at Berkeley, the University of California at Los Angeles, Michigan, and Wisconsin. To what extent is the prominence of such institutions attributable to their perceived excellence across many fields? How well do Canadian institutions fare in our Canadian-US sample in terms of their overall performance across disciplines? Is the strength of the Canadian performance the result of occasional strength in fields by a variety of different institutions, or do some Canadian institutions perform well across a range of areas? As in the previous analysis, we consider performance with respect to both the number of papers a university's faculty publishes and the impact of these papers as indicated by the frequency with which they are cited.

Institutions and Papers

Table 6 shows how often universities from our sample ranked in the top ten institutions across 21 disciplines covered by our study in terms of the number of papers they published from 1994 to 1998. In general, these data reveal a substantial concentration of high rankings among relatively few institutions. The top 11 institutions

Table 6: ***Top US and Canadian Universities, by Number of Papers Published, 1994–98***

Institution	Papers		Citations	
	Rank by Disciplines in Top 10	Number of Disciplines in Top 10	Rank by Disciplines in Top 10	Number of Disciplines in Top 10
University of Toronto	1	10	27T	2
Harvard University	2T	9	1T	16
Massachusetts Institute of Technology	2T	9	4T	8
University of California at Berkeley	2T	9	27	2
University of Michigan	2T	9	16T	4
University of Minnesota	2T	9	27T	2
University of Wisconsin	2T	9	27T	2
Stanford University	7T	8	2	13
Univ. of California at San Francisco	7T	8	3	11
Johns Hopkins University	9T	7	20T	3
University of Washington	9T	7	20T	3
Univ. of California at Los Angeles	9T	7	27T	2
McGill University	17T	4		0
University of Guelph	32T	2		0
Université de Montréal	38T	1		0

Note: Ranks are reported as the best ranking of a group that is tied (T).

Sources: Derived from Institute for Scientific Information 1981–98a; 1981–98b.

— there was a tie for tenth place — of the 177 in the two data sets account for 48 percent of the possible 210 top-ten rankings over the fields surveyed. Overall, the composition of this list of top-ranked institutions is not surprising in that it includes mainly institutions with well-recognized reputations. It also features a mix of private and public institutions: seven of the top 11 US institutions by this measure are publicly funded.

Most illustrative for the Canadian-US comparisons that are the central concern of this paper is the position of University of Toronto: it had more top-ten rankings with respect to papers published than any other institution in the two countries. Other Canadian

institutions also fared well: McGill ranked 17th, and both Guelph and Université de Montréal ranked in the 30s with two and one top-ten finish, respectively. On this basis, top Canadian institutions appear to compare favorably with top US institutions in demonstrating strength across a number of fields.

Institutions and Impact

A very different picture emerges, however, when one looks at the impact of published papers (see Table 7). The US rankings are dominated by private institutions, which accounted for nine of the top 11 positions. And while the top 11 institutions accounted for a share similar to that for the top institutions by papers published, there was a much greater concentration among the most highly ranked institutions. The top three — Harvard, Stanford, and the University of California at San Francisco — accounted for 40 top-ten ranks with respect to paper impact; the top three schools in Table 6 supplied just 28 top-ten ranks for papers published. Interestingly, the three institutions at the head of Table 7 are the only ones that appear in the top ten of both rankings.

The differences discussed earlier between measures of performance by the number of papers published per discipline and their impact are even more pronounced in these university-wide comparisons. The University of Toronto, the top-ranked Canadian institution with respect to article impact, features in the top ten in only two fields, giving it a tie for twenty-eighth place, compared with its first-place finish in terms of the number of papers published. Indeed, Simon Fraser is the only other Canadian university to rank in the top ten in any discipline with respect to article impact.

Size and Performance

As discussed earlier, an institution's size can be expected to be an important determinant of the number of papers it publishes, but it is less likely to affect performance with respect to paper impact. Table 8 shows that, on average, the top ten institutions by number of papers published had more than twice the level of enrollments

Table 7: ***Top US and Canadian Universities, by Citations per Paper, 1994–98***

Institution	Citations		Papers	
	Rank by Disciplines in Top 10	Number of Disciplines in Top 10	Rank by Discipline in Top 10	Number of Disciplines in Top 10
Harvard University	1	16	2T	9
Stanford University	2	13	8T	8
Univ. of California at San Francisco	3	11	8T	8
Massachusetts Institute of Technology	4T	8	2T	9
University of California at San Diego	4T	8	17	4
Princeton University	6T	7		0
University of Pennsylvania	6T	7	13T	6
Duke University	6T	7		0
University of Chicago	9T	6		0
Columbia University	9T	6	17	4
Yale University	9T	6	26T	3
University of Toronto	27T	2	1	10
Simon Fraser University	55T	1		0

Note: Ranks are reported as the best ranking of a group that is tied (T).

Sources: Derived from Institute for Scientific Information 1981–98a; 1981–98b.

of the top ten institutions ranked by paper impact. This finding suggests that the good performance of Canadian institutions with respect to the number of papers published may be due to their relatively large size.[8]

Institutions Overall

The analysis of how Canadian universities fared relative to their US counterparts with respect to papers published and citations over the 1994–98 period offers some insights about their research

8 Enrollment at the University of Guelph is, however, lower than all but two of the top ten universities by number of papers published.

Table 8: ***Size of Top Ten Canadian and US Universities, by Citations per Paper and Number of Papers Published***

Enrollment	Number in Top Ten by Citations per Paper	Number in Top Ten by Papers Published
More than 30,000	7	0
20,000–30,000	1	3
10,000–20,000	2	5
Less than 10,000	1	3
Average enrollment	30,697	14,278

Note: The number of institutions in each case is 11 to take account of ties.

Sources: US universities: United States, Department of Education, National Center for Education Statistics, *Integrated Postsecondary Education Data System (IPEDS), Fall Enrollment 1997*; Canadian universities: Association of Universities and Colleges of Canada, *Full-Time and Part-Time Enrollment by Institution and Level*; available from Internet website www.aucc.ca/en/research/enr_inst2.htm.

performance over the period. In terms of number of papers published, the rankings suggest that there is no difference in research productivity between top Canadian and US universities in this respect. Indeed, one Canadian university ranked in the top ten in this area in more fields than did any US university.

Canadian universities performed less well with respect to citations per paper, a measure of the quality of research. No Canadian university ranked in the top 20, only one was in the top 30, and one other with at least one top-ten ranking in a particular discipline managed only a share of fifty-fifth place overall. By this measure, private US universities, which tend to be smaller than state-supported research universities, dominated both Canadian and US public institutions, accounting for all but three of the top 11 rankings.

Conclusions

Our analysis provides new results about the research performance of Canadian universities relative to universities in the United

States. Our approach is quite rudimentary and takes into account neither the relative size of Canadian universities nor the resources available to them for research. Given these limits, the analysis suggests a striking finding about Canadian research efforts. The top Canadian universities perform reasonably well with respect to the volume of their publications in the fields surveyed, but lag substantially behind the top US universities in terms of the recognition their research garners from scholars, a widely agreed-on measure of the quality of research. We conclude that the quality of research at top Canadian universities falls substantially short of that found in the top US institutions.

We can only speculate about the cause of the lower quality of Canadian university research. Several possible causes are well known: Canada lacks the well-funded private research universities that exist in the United States; Canada is also poorer than its southern neighbor and the provinces provide a lower level of financial support for their universities than do many US states. The level of research funding from the federal government also falls short of that available in the United States.

We raise the possibility of a further relevant factor: differences in the approach to funding university research in the two countries. Canadian policy appears to stress criteria other than the excellence of the research itself. Surprisingly, excellence seems to play a relatively minor role in the National Research Council's (NRC's) process for choosing among research projects.

Canadian chemist and Nobel laureate John Polanyi characterizes the role of excellence in Canadian criteria for research funding as follows:

> I have beside me...the guidelines for participation in what is called a Canadian Centre of Excellence. These exist...primarily to foster university research. The reference to "excellence" acknowledges...that it is the vision (the free enterprise, if that is your line of business) of a small number of researchers that lead to new ideas that matter. So pick the best scientists (excellent, you know) and give them freedom — just so long as they remain the best. This is how it should be done.

> But it's not what we do. In our hunger for payoff, our Centres of Excellence give a miserable 20 percent weight to excellence. The remaining 80 percent of the marks in the selection process are for such voguish things as interdisciplinarity, inter-institutional relations, management structure, relevance, training and socio-economic impact. (That was easy to write; I copied it from the form.)
>
> Applications for funding must address these criteria. They are then sent for evaluation to the scientific peers of the applicant, who pretend to judge worth on this absurd basis. It is absurd, since university research is performed (or should be) in the marketplace for ideas, and not that for devices. (Polanyi 2000.)

In the United States, in contrast, the merit review process under which the National Science Foundation (NSF) allocates research funds has two main criteria: what is the intellectual merit of the proposed activity? what are the broader impacts of the proposed research?

The NSF, like the NRC, also considers criteria other than excellence in making its funding decisions. Its guidelines stress that criteria related to the broader impacts be "considered and addressed in both proposals and reviews," and that staff will give careful consideration to the "integration of research and education" and "integrating diversity into NSF programs, projects and activities" (NSF 2000, 1). But its emphasis appears different. The NSF mentions neither interdisciplinarity nor inter-institutional relations. Moreover, its guidelines do not prescribe the weights the various elements should receive. To the contrary, they suggest that reviewers "be asked to address only those that are relevant to the proposal." Scholars familiar with practice in the two countries assure us that criteria other than simple intellectual excellence are taken much more seriously in Canada.

Polanyi's discussion suggests that those who set the criteria for success used in Canadian research funding policy might consider our concerns to be largely irrelevant. They might argue that research in the two countries should not be compared solely in terms of excellence, and that other criterial should also be taken into account. We do not accept this view. We agree with Polanyi

that excellence should be the predominant goal. Greater emphasis on excellence in research will benefit Canadians. Success in research is important for the students going through university. It is part of the way they signal their quality to top graduate schools when they apply for further studies, and it is part of the way they signal to employers that they are qualified for jobs requiring scholastic accomplishment and skill.

Canadian policymakers do not appear to accept the view that support for science research should be concerned solely with fostering new ideas that matter. Possibly they believe that the other values they factor into funding decisions — interdisciplinarity, inter-institutional relations, relevance, training and socio-economic impact — can be achieved with little cost in terms of the pursuit of excellence. Our work suggests, however, that these add-ons may come at a cost. Our top research universities lag well behind their counterparts in the United States in creating ideas that other scholars notice. We believe these differences in national research policies may be a factor. Still, any definite conclusion about the sources of the differences in performance requires further work.

References

Institute for Scientific Information. 1981–98a. *Canadian University Science Indicators*. Philadelphia: ISI Thomson Scientific. Diskette.

———. 1981–98b. *U.S. University Science Indicators*. Philadelphia: ISI Thomson Scientific. Diskette.

National Science Foundation. 2000. *Grant Proposal Guide*. Washington, DC: NSF.

Polanyi, J. 2000. "Review: The equation that rocked the planet." *Globe and Mail* (Toronto), November 4, p. D6.

Science Watch. 1992. "If Quebec Separates, Will Canadian Science Suffer?" June/July, pp. 1–2, 7–8.

———. 1995. "University of Toronto Triumphs in Tally of Canada's Tip-Top Talent." November/December, pp. 1–2.

Strauss, S. 1995. "Bigger not always better in academic publishing." *Globe and Mail* (Toronto), October 27, p. 6.

Appendix Tables

Table A-1: ***Universities in the Canadian Data Set***

Acadia University
Bishop's University
Brandon University
Brock University
Carleton University
Concordia University
Dalhousie University
Daltech
École de Technologie Supérieure
École des Hautes Études Commerciales
École Nationale d'Administration Publique
École Polytechnique de Montréal
Institut Armand-Frappier
Institut National de la Recherche Scientifique
Lakehead University
Laurentian University
McGill University
McMaster University
Memorial University of Newfoundland
Mount Allison University
Mount Saint Vincent University
Ontario Institute of Education
Queen's University
Royal Military College of Canada
St. Francis Xavier University
Saint Mary's University
St. Michael's College
St. Paul University
Simon Fraser University
Trent University
Trinity College
Trinity Western University
Université de Moncton
Université de Montréal
Université de Sherbrooke
Université du Québec
Université du Québec à Chicoutimi
Université du Québec à Hull
Université du Québec à Montréal
Université du Québec à Rimouski
Université du Québec à Trois-Rivières
Université du Québec en Abitibi-Témiscamingue
Université Laval
University of Alberta
University of British Columbia
University of Calgary
University of Guelph
University of Lethbridge
University of Manitoba
University of New Brunswick
University of Northern British Columbia
University of Ottawa
University of Prince Edward Island
University of Regina
University of Saskatchewan
University of Toronto
University of Victoria
University of Waterloo
University of Western Ontario
University of Windsor
University of Winnipeg
Victoria University
Wilfrid Laurier University
York University

Table A-2: *Universities in the US Data Set*

Arizona State University	Rice University
Baylor College of Medicine	Rockefeller University
Boston University	Rutgers State University
Brandeis University	Stanford University
Brown University	State University of New York at Buffalo
California Institute of Technology	State University of New York atStony Brook
Carnegie-Mellon University	Syracuse University
Case Western Reserve University	Texas A&M University
City University of New York	Tufts University
Colorado State University	Tulane University
Columbia University	University of Alabama
Cornell University	University of Alaska
Dartmouth College	University of Arizona
Duke University	University of California at Berkeley
Emory University	University of California at Davis
Florida State University	University of California at Irvine
Georgetown University	University of California at Los Angeles
Georgia Institute of Technology	University of California at Riverside
Harvard University	University of California at San Diego
Indiana University	University of California at San Francisco
Iowa State University	University of California at Santa Barbara
Johns Hopkins University	University of California at Santa Cruz
Lehigh University	University of Chicago
Louisiana State University	University of Cincinnati
Loyola University	University of Colorado
Massachusetts Institute of Technology	University of Connecticut
Michigan State University	University of Delaware
New Mexico State University	University of Florida
New York University	University of Georgia
North Carolina State University	University of Hawaii
Northwestern University	University of Illinois at Chicago
Ohio State University	University of Illinois at Urbana
Oregon Health Science University	University of Iowa
Oregon State University	University of Kansas
Pennsylvania State University	University of Kentucky
Princeton University	University of Maryland at Baltimore
Purdue University	University of Maryland at College Park

Table A-2 - continued

University of Massachusetts
University of Massachusetts at Amherst
University of Massachusetts at Worcester
University of Miami
University of Michigan
University of Minnesota
University of Missouri
University of Nebraska
University of New Hampshire
University of New Mexico
University of North Carolina at Chapel Hill
University of Oregon
University of Pennsylvania
University of Pittsburgh
University of Rochester
University of Southern California
University of Tennessee
University of Texas at Austin
University of Texas at Dallas
University of Texas at Houston
University of Texas at San Antonio Health Science Center
University of Utah
University of Vermont
University of Virginia
University of Washington
University of Wisconsin at Madison
Utah State University
Vanderbilt University
Virginia Commonwealth University
Virginia Polytechnic Institute
Wake Forest University
Washington State University
Washington University
Wayne State University
West Virginia University
Woods Hole Oceanographic Institute
Yale University
Yeshiva University

Table A-3: ***Research Performance of Canadian Universities, by Number of Papers Published, 1994–98***

Discipline	Top 3 Canadian Universities	Number of Papers Published	Average Number of Papers Published: By Top 3 Canadian Universities	Average Number of Papers Published: By Top 3 US and Canadian Universities	Rank	Average Rank of Top 3 Canadian Universities
Agricultural sciences			418	729		16
	U. of Guelph	589			7	
	McGill U.	399			17	
	U. of Alberta	267			24	
Astrophysics			230	1,342		33
	U. of Toronto	358			18	
	U. de Montréal	189			35	
	U. of British Columbia	143			43	
Biology and biochemistry*			1,775	3,084		13
	U. of Toronto	2,278			3	
	McGill U.	1,863			8	
	U. of Alberta	1,186			27	
Chemistry			1,209	1,972		17
	U. of Toronto	1,331			10	
	U. of British Columbia	1,202			23	
	McGill U.	1,096			29	
Clinical medicine			6,182	10,985		13
	U. of Toronto	9,454			2	
	McGill U.	5,442			13	
	McMaster U.	3,651			24	

Computer science			185	290		16
	U. of Toronto	215			8	
	U. of Waterloo	213			10	
	U. of British Columbia	128			29	
Ecology/environment			400	677		17
	U. of British Columbia	464			12	
	U. of Alberta	387			16	
	U. of Waterloo	348			24	
Economics and business			271	771		34
	U. of British Columbia	349			22	
	U. of Toronto	274			32	
	U. of Western Ontario	189			48	
Education			118	192		16
	U. of Toronto	151			5	
	U. of Alberta	115			17	
	U. of British Columbia	90			27	
Engineering						21
	U. of Toronto	1,089			15	
	U. of Waterloo	946			20	
	U. of British Columbia	793			29	
Geosciences			511	1,127		21
	U. of Toronto	543			19	
	U. of British Columbia	511			21	
	McGill U.	479			22	
Immunology			405	1,105	30	
	U. of Toronto	559			7	
	McGill U.	359			20	
	U. of British Columbia	296			29	
Materials sciences			388	717		15
	U. of Toronto	466			8	
	McGill U.	393			15	
	U. of British Columbia	305			21	

Table A-3 - continued

Discipline	Top 3 Canadian Universities	Number of Papers Published	Average Number of Papers Published: By Top 3 Canadian Universities	Average Number of Papers Published: By Top 3 US and Canadian Universities	Rank	Average Rank of Top 3 Canadian Universities
Mathematics			326	566		19
	U. of Waterloo	363			14	
	U. of Toronto	327			19	
	U. of Alberta	289			25	
Microbiology*			342	680		21
	McGill U.	381			14	
	U. of British Columbia	354			17	
	U. of Toronto	290			31	
Molecular biology			1,046	2,056		13
	U. of Toronto	1,308			4	
	McGill U.	1,242			5	
	McMaster U.	587			30	
Neurosciences			1,349	2,061		12
	U. of Toronto	1,650			4	
	McGill U.	1,648			5	
	U. of British Columbia	749			28	
Pharmacology*			423	505*		7
	U. of Toronto	499			2	
	McGill U.	397			9	
	U. de Montréal	374			10	

Physics			1,313	3,495		29
	U. of Toronto	1,367			28	
	U. of British Columbia	1,287			29	
	McGill U.	1,286			30	
Plant and animal sciences			1,226	3,281		17
	U. of Guelph	1,674			8	
	U. of British Columbia	1,079			19	
	U. of Saskatchewan	929			24	
Psychology and psychiatry			886	1,458		42
	U. of Toronto	1,294			3	
	McGill U.	708			16	
	U. of British Columbia	657			21	

* A Canadian university ranks in the top three overall in this discipline.

Sources: Institute for Scientific Information 1981–98a; 1981–98b.

Table A-4: ***Research Performance of Canadian Universities, by Number of Citations per Published Paper, 1994–98***

Discipline	Top 3 Canadian Universities	Number of Citations per Paper Published	Average Number of Citations per Paper: By Top 3 Canadian Universities	Average Number of Citations per Paper: By Top 3 US and Canadian Universities	Rank	Average Rank of Top 3 Canadian Universities
Agricultural sciences			2.8	4.6		13
	U. of Toronto	2.84			10	
	McMaster U.	2.83			11	
	U. of British Columbia	2.66			17	
Astrophysics			9.3	12.8		17
	U. of Toronto	11.11			7	
	U. of British Columbia	8.80			20	
	U. de Montréal	8.12			25	
Biology and biochemistry			8.6	16.7		37
	U. of Toronto	9.47			31	
	U. of Alberta	8.56			38	
	McGill U.	7.74			41	
Chemistry			5.7	9.5		42
	U. de Montréal	6.34			29	
	U. of Toronto	5.29			46	
	U. of Calgary	5.02			51	
Clinical medicine			6.3	9.2		36
	McMaster U.	6.78			32	
	U. of British Columbia	6.08			37	
	U. of Western Ontario	5.92			38	

Computer science			1.4	2.8		38
	U. of Victoria	1.38			47	
	McMaster U.	1.37			49	
	U. de Québec à Montréal	1.35			52	
Ecology/environment			4.6	6		22
	U. of Waterloo	4.69			13	
	U. of Toronto	3.97			24	
	U. of British Columbia	3.71			280	
Economics and business			1.8	3.9		42
	U. of British Columbia	1.99			37	
	U. of Western Ontario	1.66			43	
	U. of Toronto	1.62			45	
Education			2	2.6		24
	Simon Fraser U.	3.18			1	
	Ontario Inst. for Studies in Education	1.59			24	
	U. of Toronto	1.10			43	
Engineering			1.8	3.1		36
	U. of Waterloo	2.13			28	
	McGill U.	1.66			39	
	U. of Toronto	1.63			40	
Geosciences			4.0	8.7		39
	Dalhousie U.	4.14			37	
	U. de Québec à Montréal	3.9			40	
	U. of Toronto	3.89			41	
Immunology			10.9	25.4		25
	U. of Toronto	11.85			18	
	McMaster U.	10.79			27	
	U. de Montréal	10.56			29	
Materials sciences			3.1	6.8		19
	U. of Toronto	3.58			8	
	U. de Laval	2.93			23	
	McMaster U.	2.93			26	

Table A-4 - continued

Discipline	Top 3 Canadian Universities	Number of Citations per Paper Published	Average Number of Citations per Paper: By Top 3 Canadian Universities	Average Number of Citations per Paper: By Top 3 US and Canadian Universities	Rank	Average Rank of Top 3 Canadian Universities
Mathematics			1.6	3.2		37
	Simon Fraser U.	1.74			27	
	U. of Toronto	1.66			35	
	U. of British Columbia	1.48			49	
Microbiology			6.5	17.5		54
	McGill U.	7.36			48	
	U. of Alberta	6.99			53	
	U. of British Columbia	6.05			61	
Molecular biology			13.8	35.4		36
	U. of Toronto	16.16			28	
	McGill U.	13.92			37	
	McMaster U.	11.85			42	
Neurosciences			8.1	17.5		35
	U. of British Columbia	8.69			31	
	McGill U.	7.78			37	
	U. of Toronto	7.63			38	
Pharmacology			6.5	1.6		25
	U. of Western Ontario	7.01			20	
	U. de Sherbrooke	6.2			27	
	McGill U.	6.19			28	

Physics			6.3	11.8		31
	McGill U.	6.99			19	
	U. of Toronto	6.42			32	
	U. of British Columbia	5.41			41	
Plant and animal sciences			3.6	6.2		19
	U. of Toronto	3.89			13	
	McGill U.	3.7			18	
	U. of British Columbia	3.13			26	
Psychology/psychiatry			3.9	7.4		37
	McMaster U.	4.25			28	
	McGill U.	3.75			40	
	U. of Toronto	3.65			43	

Sources: Institute for Scientific Information 1981–98a; 1981–98b.

Table A-5: ***Changes in Rankings of Canadian Universities, by Number of Papers Published, 1981–98***

Discipline		Rank				Change from 1981–84 to 1994–98
		1981–85	1984–88	1989–93	1994–98	
Agricultural sciences	average of top 3	27	23	17	16	–11
	1st ranked	16	14	8	7	
	2nd ranked	32	24	21	17	
	3rd ranked	33	30	23	24	
Astrophysics	average of top 3	33	28	23	32	0
	1st ranked	21	17	14	18	
	2nd ranked	36	30	24	35	
	3rd ranked	42	38	32	43	
Biology and biochemistry	average of top 3	21	19	17	13	–8
	1st ranked	8	6	5	3	
	2nd ranked	19	18	20	8	
	3rd ranked	36	32	25	27	
Chemistry	Average of top 3	15	15	21	17	+2
	1st ranked	11	13	12	10	
	2nd ranked	14	15	22	17	
	3rd ranked	20	18	30	23	
Clinical medicine	average of top 3	23	20	16	13	–10
	1st ranked	4	4	2	2	
	2nd ranked	23	22	22	13	
	3rd ranked	42	34	25	24	
Computer science	average of top 3	14	20	29	16	2
	1st ranked	5	8	18	8	
	2nd ranked	9	13	27	10	
	3rd ranked	29	38	41	29	
Ecology/ environment	average of top 3	28	24	21	17	–11
	1st ranked	23	17	18	12	
	2nd ranked	35	26	19	16	
	3rd ranked	36	29	25	24	
Economics	average of top 3	30	28	36	34	+4
	1st ranked	29	26	28	22	
	2nd ranked	30	28	36	32	
	3rd ranked	32	30	45	48	

Table A-5 - continued

Discipline		Rank				Change from 1981–84 to 1994–98
		1981–85	1984–88	1989–93	1994–98	
Education	average of top 3	23	18	20	16	–7
	1st ranked	15	9	6	5	
	2nd ranked	25	16	18	17	
	3rd ranked	28	28	37	27	
Engineering	average of top 3	20	22	21	21	+1
	1st ranked	14	17	18	15	
	2nd ranked	20	20	19	20	
	3rd ranked	27	28	25	28	
Geosciences	average of top 3	17	15	18	21	+4
	1st ranked	12	9	12	19	
	2nd ranked	17	15	20	21	
	3rd ranked	21	21	21	22	
Immunology	average of top 3	26	25	22	19	–7
	1st ranked	10	7	9	7	
	2nd ranked	28	27	26	20	
	3rd ranked	40	41	32	29	
Mathematics	average of top 3	27	24	22	19	–8
	1st ranked	25	19	20	14	
	2nd ranked	26	22	21	19	
	3rd ranked	30	32	24	25	
Materials sciences	average of top 3	16	17	19	15	–1
	1st ranked	14	12	14	8	
	2nd ranked	15	15	20	15	
	3rd ranked	18	23	24	21	
Microbiology	average of top 3	27	24	25	21	–6
	1st ranked	13	16	23	14	
	2nd ranked	31	22	25	17	
	3rd ranked	34	35	27	31	
Molecular biology	average of top 3	27	18	18	13	–14
	1st ranked	14	6	5	4	
	2nd ranked	33	24	20	5	
	3rd ranked	34	25	28	30	

Table A-5 - continued

Discipline		Rank 1981–85	1984–88	1989–93	1994–98	Change from 1981–84 to 1994–98
Neurosciences	average of top 3	14	10	9	12	–2
	1st ranked	4	3	4	4	
	2nd ranked	11	7	5	5	
	3rd ranked	28	21	19	28	
Pharmacology	average of top 3	13	11	10	7	–6
	1st ranked	1	1	1	2	
	2nd ranked	15	15	12	9	
	3rd ranked	22	17	18	10	
Physics	average of top 3	26	29	23	29	+3
	1st ranked	19	22	18	28	
	2nd ranked	23	27	21	29	
	3rd ranked	35	39	31	30	
Plant and animal sciences	average of top 3	17	16	16	17	0
	1st ranked	5	5	5	8	
	2nd ranked	23	19	20	19	
	3rd ranked	24	24	22	24	
Psychology	average of top 3	22	18	17	13	–9
	1st ranked	4	3	3	3	
	2nd ranked	29	25	22	16	
	3rd ranked	34	26	27	21	
All disciplines	average of top 3	22.1	20.2	20.0	18.5	–3.6
	1st ranked	12.7	11.1	11.6	10.1	–2.6

Sources: Institute for Scientific Information 1981–98a; 1981–98b.

Table A-6: *Changes in Rankings of Canadian Universities, by Citations per Paper, 1981–98*

Discipline		Rank				Change from 1981–84 to 1994–98
		1981–85	1984–88	1989–93	1994–98	
Agricultural sciences	average of top 3	8	13	20	13	+5
	1st ranked	6	5	16	10	
	2nd ranked	8	16	18	11	
	3rd ranked	10	19	26		17
Astrophysics	average of top 3	37	34	21	17	–20
	1st ranked	34	21	9	7	
	2nd ranked	37	39	23	20	
	3rd ranked	39	43	32	25	
Biology and biochemistry	average of top 3	46	27	39	37	–9
	1st ranked	44	10	29	31	
	2nd ranked	47	31	43	38	
	3rd ranked	48	39	44	41	
Chemistry	average of top 3	39	46	60	42	+3
	1st ranked	31	43	54	29	
	2nd ranked	38	46	58	46	
	3rd ranked	49	48	67	51	
Clinical medicine	average of top 3	44	43	41	36	–8
	1st ranked	42	37	39	32	
	2nd ranked	43	45	42	37	
	3rd ranked	47	47	43	38	
Computer science	average of top 3	17	25	23	49	+31
	1st ranked	10	10	9	47	
	2nd ranked	13	30	29	49	
	3rd ranked	29	34	32	52	
Ecology/ environment	average of top 3	30	27	16	22	–8
	1st ranked	20	23	15	13	
	2nd ranked	34	27	16	24	
	3rd ranked	36	31	17	28	
Economics	average of top 3	19	20	36	42	+23
	1st ranked	10	18	31	37	
	2nd ranked	21	21	35	43	
	3rd ranked	27	22	43	45	

Table A-6 - continued

Discipline		Rank				Change from 1981–84 to 1994–98
		1981–85	1984–88	1989–93	1994–98	
Education	average of top 3	35	21	29	29	–6
	1st ranked	27	10	18	1	
	2nd ranked	30	26	24	34	
	3rd ranked	48	37	40	43	
Engineering	average of top 3	22	19	21	33	+11
	1st ranked	19	11	18	20	
	2nd ranked	21	22	19	39	
	3rd ranked	26	25	25	40	
Geosciences	average of top 3	34	36	34	39	+5
	1st ranked	32	35	28	37	
	2nd ranked	35	36	36	40	
	3rd ranked	36	37	38	41	
Immunology	average of top 3	39	31	24	25	–14
	1st ranked	30	13	15	18	
	2nd ranked	39	37	23	27	
	3rd ranked	48	42	33	29	
Mathematics	average of top 3	27	37	30	37	+10
	1st ranked	19	35	28	27	
	2nd ranked	23	36	29	35	
	3rd ranked	40	41	32	49	
Materials sciences	average of top 3	29	25	38	19	–10
	1st ranked	23	21	32	8	
	2nd ranked	31	26	40	23	
	3rd ranked	34		28	42	26
Microbiology	average of top 3	39	47	41	54	+15
	1st ranked	33	36	37	48	
	2nd ranked	38	51	41	53	
	3rd ranked	46	52	44	61	
Molecular biology	average of top 3	40	39	34	36	–4
	1st ranked	36	29	17	28	
	2nd ranked	40	42	41	37	
	3rd ranked	44	47	44	42	

Table A-6 - continued

Discipline		Rank				Change from 1981–84 to 1994–98
		1981–85	1984–88	1989–93	1994–98	
Neurosciences	average of top 3	30	40	33	35	+5
	1st ranked	24	37	25	31	
	2nd ranked	30	40	29	37	
	3rd ranked	37	44	45	38	
Pharmacology	average of top 3	14	31	25	25	+11
	1st ranked	6	10	5	20	
	2nd ranked	10	25	32	27	
	3rd ranked	25	39	37	28	
Physics	average of top 3	42	40	38	27	–11
	1st ranked	39	39	30	19	
	2nd ranked	41	40	35	32	
	3rd ranked	45	42	49	41	
Plant and animal sciences	average of top 3	17	12	18	19	+2
	1st ranked	11	6	14	13	
	2nd ranked	18	15	18	18	
	3rd ranked	21	16	23	26	
Psychology and psychiatry	average of top 3	26	29	28	37	+11
	1st ranked	23	30	15	28	
	2nd ranked	24	33	38	40	
	3rd ranked	31	34	40	43	
All disciplines	average of top 3	30.0	30.4	30.9	32.3	2.3
	1st ranked	24.8	22.8	23.2	24.0	–0.8

Sources: Institute for Scientific Information 1981–98a; 1981–98b.

A Matter of Discipline:
Early Career Outcomes of Recent Canadian University Graduates

Ross Finnie

It is obvious that the career outcomes of university graduates vary to a great degree according to their fields of study, but the empirical evidence on the extent of these differences in Canada is actually quite scant.[1] And yet the issue is as important as it is intriguing.

The principal contribution of this paper is thus to exploit the unique National Graduates Survey (NGS) databases in order to present new evidence on earnings differences by discipline among three cohorts of recent Canadian university graduates.

Financial support received from the Applied Research Branch of Human Resources Development Canada and the Social Sciences and Humanities Research Council of Canada is gratefully acknowledged, as are the helpful comments received from Doug Giddings, Philip Jennings, David Laidler, John Myles, Garnett Picot, Ted Wannell, and participants in the C.D. Howe Institute-sponsored session at the June 2001 meetings of the Canadian Economics Association, where this paper was first presented. The detailed suggestions provided by Jeffrey Smith are particularly appreciated. The participation of Marc Frenette in this research, including his co-authorship of a related paper (Finnie and Frechette forthcoming), is noted with pleasure. The copy editing of Elizabeth d'Anjou was beneficial and instructive. Barry Norris shepherded the paper through all stages of production with skill and grace.

1 The literature includes Cohn (1997); Côté and Sweetman (1997); Dodge and Stager (1972); Finnie (1995); Mehmet (1977); Stager (1996); and Vaillancourt (1995). In some of these papers, earnings patterns by discipline are used principally as inputs for calculating rates of return to education along this dimension; in others, they are the focus.

A second contribution of the paper is to develop a simple index of the conditional variability of earnings (that is, their variability after controlling for various personal attributes) within given disciplines, and to determine whether or not intradisciplinary earnings inequality has increased over the period covered by the analysis, a time when labor market inequality, as measured in more conventional fashions, has generally increased.

Finally, the paper also includes an analysis of the distribution of graduates by field of study and the male-female splits in each field, of unemployment rates, and of students' overall evaluations of their choice of discipline, all as a run-in to the analysis of earnings differences that makes up the bulk of this paper.[2]

These results should be of interest for a number of reasons. First, subject to some important caveats, they provide new information on the relative returns to different types of human capital represented by the various disciplines.[3] And recent graduates are an especially interesting group in this regard because, as new labor market entrants, they may be harbingers of future trends and because recent evidence indicates that the major portion of real lifetime earnings growth occurs during the early years of individuals' careers (Murphy and Welch 1990).

Policymakers should find such evidence pertinent to their thinking about differences in the value of different kinds of postsecondary

2 Companion papers include Finnie (2001), which reports a range of other outcomes using simpler (non-econometric) techniques; Betts, Ferrall, and Finnie (1999), which includes field-of-study variables in an econometric analysis of school quality on graduates' earnings; and Lavoie and Finnie (1999), which compares the outcomes of science and engineering students with others over a range of outcomes. Finnie (1999) uses the same data to look at earnings and other labor-market outcomes for graduates by level of education (college, bachelor's, master's and doctorate) and by sex, but not by field of study, while Finnie (2000a) more fully exploits the longitudinal aspect of the NGS data to look at the evolution of various labor market outcomes in the years following graduation.

3 It should be noted that this paper does not present any sort of formal rate-of-return analysis in this regard. See the paper by Vaillancourt and Bourdeau-Primeau in this volume for such an exercise.

education and in setting priorities in terms of expanding enrollments and educational resource allocation in general.

The results should also be relevant to a variety of other post-secondary education policy issues. For example, they could be useful in determining the different shares of education costs that students of different disciplines might be expected to bear if a policy of differential fees were introduced, and would help in designing or estimating the effects of an income-contingent loan repayment system or other student assistance programs.

The findings could also be useful for young people about to make choices regarding what field of study to enter, since better decisions should result from an improved understanding of the earnings patterns — as well as employment rates and overall evaluations — associated with each option, while graduates who have already been through the system might be interested in comparing their own experiences to those of others.

For readers with a more academic bent, the analysis should cast in a new light previous studies of this type carried out both in Canada and in other countries. It groups disciplines differently from some of these earlier studies, with sometimes surprising findings. It offers more precise tracking of outcomes over time than most, both from one cohort to another and over the years following graduation within each group. And it provides some distinctive measures not available in other studies, such as graduates' overall evaluation of their chosen programs.

Finally, it is very interesting to compare these results to those found elsewhere, notably the United States, thus leading to some very important questions pertaining to differences in labor markets and the university system.

The Data

First, a look at the data — its source, the selection of the samples, and the choice of discipline groups.[4]

4 See Finnie (2000b) for more detailed discussion of the material covered in this section.

The National Graduates Surveys

This analysis employs the data from the NGS and associated Follow-Up surveys. This unique series of databases, developed by Statistics Canada in conjunction with Human Resources Development Canada, comprise large, representative samples of those who successfully completed programs at Canadian colleges and universities in 1982, 1986, and 1990. For each group of graduates, information was gathered during interviews carried out two years and then five years after graduation (that is, in 1984 and 1987; 1988, and 1991; and 1992 and 1995).

These databases have numerous strengths for a study of this type. First, the fact that data were gathered at two interviews for each cohort allows for tracking the evolution of differences in earnings and the other outcomes considered in the years following graduation — and in a very precise fashion. Furthermore, the five-year interviews, which were conducted at a point where the average age of the graduates was over 30, provide a longer-run perspective on earnings patterns.

Second, the availability of data for three different cohorts of graduates permits the separation of the more stable patterns from those that have been more volatile, as well as the identification of trends. This perspective is of particular interest because the period under study (the early 1980s through the mid-1990s) was characterized by important labor market changes, especially for younger workers.

Third, the large sample sizes (30,000 to 35,000 observations per survey) and the representative nature of the NGS data mean that the analysis can be conducted at the desired level of detail, and that the results should generalize to the full population of graduates.[5]

---

5 The NGS databases are based on a stratified sampling scheme (by province, level of education, and field of study). All results reported below reflect the appropriate sample weights and should be representative of the relevant underlying populations of graduates in each year. The databases also include graduates of colleges, trade schools, and vocational schools, as well as university graduates at the master's and PhD levels; those groups are not, however, included in the current analysis.

Finally, sufficient control variables are included in the databases to permit the estimation of the sort of earnings models that are standard in this literature.

In summary, the three NGS databases facilitate a focused, detailed, and dynamic analysis of the earnings patterns and other outcomes by field of study of Canadian bachelor's-level graduates in the critical five years following graduation from the early 1980s into the mid-1990s. These data are not only valuable in a Canadian context, but unique at the international level.

Selection of the Working Samples

The analysis was carried out using bachelor's-level graduates who were under age 35 and had fewer than five years of full-time work experience at the time of graduation. The analysis thus focuses on graduates with "normal" career profiles, who had finished their studies and were at the point of entering the labor market. Individuals were excluded if they obtained an additional degree over the period observed — except in the initial part of the analysis, which looks at individuals' overall evaluations of their programs — or were part-time workers who cited school as the reason for having only partial involvement in the labor market, since such people clearly had not finished their studies and entered the labor market in full as of the year of graduation in question (1982, 1986, 1990).[6] The relatively small number of individuals who were neither regular wage earners nor self-employed workers (for example,

6 An argument could be made for including individuals who went on to a graduate degree in the analysis, but this approach was not followed here. One reason is that students in this category mix school and work after the original graduation date, and the results would reflect this combination of activities, thus deviating from the clean two- and five-year postgraduation profiles provided for non-continuers. Second, the interdiscipline differences in earnings at the graduate level may well differ from those at the bachelor's level; the results would, therefore, mix the effects that hold at the different levels, yet in a noncomplete fashion (since only those who went on to graduate school and finished within the two- or five-year windows provided here would be included in the group of graduate students).

volunteers or family workers), who failed to provide the information required for any part of the analysis, or who were deemed to have unreasonably low earnings (less than $5,000 at annualized rates for full-time workers), were also excluded; these criteria eliminated just 1 to 2 percent of the sample in each period.

The Discipline Groupings Employed

For the most part, the field-of-study categorizations used here reflect the major discipline groups employed in standard classification schemes and other analyses of this type. Some fine-tuning of these categorizations was, however, carried out according to a preliminary analysis of earnings patterns to ensure that like disciplines were grouped together and that those with distinctly different earnings profiles were kept separated. Thus, natural sciences and engineering, which are typically grouped into a single broad category (especially the pure and applied sciences), are here split into three separate categories; economics is separated from other social sciences. Engineering and computer science are, however, safely grouped together.

The field categorizations used in this analysis are thus as follows:

- education (includes elementary/secondary teaching and other education);
- fine arts and humanities;
- commerce (includes business administration and related fields);
- economics;
- other social sciences;
- agricultural and biological sciences;
- engineering and computer science (includes architecture);
- other health and life sciences (includes nursing and other health professions but excludes medicine and dentistry);
- mathematics and physical sciences; and
- other fields/no specialization.[7]

7 This category represents those who truly had no specialization as well as those who had one too general to fit into the other categories and too small to be put on its own, such as general social sciences.

Setting the Stage: Distributions, Evaluations, Unemployment

The presentation of the empirical results begins with a look at the distribution of graduates by discipline, their own overall evaluations of their programs, and unemployment rates. These results are interesting on their own, but they also nicely set the stage for the earnings analysis that follows.

The Distribution of Graduates by Field of Study

The distribution of graduates by field of study and the male-female composition of each discipline are shown in Table 1. The field-of-study distributions are quite different for men and women. Female graduates have been much more likely than men to graduate with degrees in education, fine arts and humanities, and other health fields, and, to a lesser degree, commerce and other social sciences. Conversely, the shares of female graduates in economics, engineering and computer science, and mathematics and physical sciences have been much lower than for men. The shares of male and female graduates in the agricultural and biological sciences have been quite similar.

Contrary to what might have been expected given a period of significant economic change, particularly in labor markets — including the emergence of the "knowledge-based economy" and a widely reported general rise in the importance of science and technology — the distributions of graduates by discipline have been quite stable. For men, there was an increase in the percentage of graduates in technical and scientific fields from the first cohort to the second (from 36 percent to 41 percent), but this share dropped back again (to 35 percent) in the third cohort, driven by the declines in engineering and computer science and in mathematics and physical sciences. These shifts were offset by mirror-image trends in the other social science category (which had 15, 12, and 15 percent of the graduates in the three cohorts). None of the other fields varied by more than one percentage point over time. As a result,

the distribution of male graduates in the third cohort was generally quite similar to that in the first.

The overall share of graduates in the four scientific and technical disciplines was even more stable across cohorts for women than for men, but at much lower rates (22, 22, and 21 percent), with engineering and computer science remaining the most glaring discrepancy in this regard (23, 24, and 20 percent for men, versus 3, 5, and 3 percent for women). More significant, perhaps, are the declines in the percentage of female graduates with degrees in education and in fine arts and humanities, and the offsetting increases in commerce and in other social sciences.

Thus, although there was no general shift of female graduates toward engineering and the sciences (as many would like to see, for various reasons) and the splits between men and women in most disciplines were quite stable, there was something of a shift in female enrollment away from certain fields they have dominated in the past and toward the slightly "harder" social sciences and business.

This change presumably reflects the growing commitment of women to the labor market, steadier job attachment, and a generally greater orientation toward careers in general — a finding consistent with the results of any number of other studies.[8]

The relative stability of the distribution of graduates, males in particular, is particularly surprising when contrasted with the shifts that have been found in the United States, where the most marked changes have been increased numbers of graduates in the more technical disciplines, especially in the case of women. These shifts have generally been interpreted as stemming from the relatively higher earnings levels that graduates in these areas have enjoyed.[9] The US literature covers a somewhat different period (the 1970s through the 1980s rather than the 1980s to 1990 as reported here for Canada). However, the findings raise a number of questions. In

8 The role of field of study in the earnings gap between male and female bachelor's-level graduates, as well as other outcomes by sex, are analyzed in Finnie and Wannell (1999).

9 See, for example, Eide 1994; Rumberger and Thomas 1993; Grogger and Eide 1995; and Turner and Bowen 1999.

Table 1: ***Distribution of Graduates by Field of Study and Sex, 1982, 1986, and 1990 Cohorts***

	Field of Study Distribution by Cohort			Sex Distribution by Cohort		
	1982	1986	1990	1982	1986	1990
			(percent)			
Males						
Education	9	9	10	26	30	31
Fine arts and humanities	13	12	13	37	37	39
Commerce	16	16	16	62	56	53
Economics	7	6	7	79	67	72
Other social sciences	15	12	15	42	33	36
Agricultural and biological sciences	6	7	7	47	48	42
Engineering and computer science	23	24	20	87	82	84
Other health and life sciences	1	2	2	14	14	19
Mathematics and other physical sciences	6	8	6	71	70	64
Other fields	3	5	4	56	50	49
Total	100	100	100	49	47	46
Females						
Education	24	19	20	74	70	69
Fine arts and humanities	20	18	18	63	63	61
Commerce	10	12	12	38	44	47
Economics	2	3	2	21	33	28
Other social sciences	21	22	23	58	67	64
Agricultural and biological sciences	7	6	8	53	52	58
Engineering and computer science	3	5	3	13	18	16
Other health and life sciences	9	8	7	86	86	81
Mathematics and other physical sciences	3	3	3	29	30	36
Other fields	2	4	4	44	50	51
Total	100	100	100	51	53	54

Note: In this and subsequent tables, the samples exclude those who were older than age 35 or who had more than five years of full-time experience by the date of graduation.

Source: Author's analysis of National Graduates Survey data, as described in the text.

particular, is this stability primarily due to demand-side or supply-side factors with respect to the education system? — that is, do the patterns reflect students' preferences or simply the spots available at universities? Has the "production" of graduates in different fields been as flexible and responsive to shifts in employment opportunities (and employers' needs) as it should be? Should the general lack of any secular shifts in the distribution of graduates by field of study be cause for worry as the economy moves in directions that seem to favor certain types of graduates over others?

Overall Evaluation of the Educational Program

The figures on graduates' overall evaluations of their choice of major (Table 2) represent the percentage of graduates who said that, given the chance, they would choose the same field of study again.[10]

Averaging over all graduates (including those who continued with their studies and are therefore excluded from the other results reported in this paper), the results indicate that approximately three-quarters of all bachelor's-level graduates were satisfied with their choices, with female graduates' scores running slightly lower than males' scores in all years. While this fraction seems high, the fact that approximately one-quarter of all graduates were not content with their choices should perhaps be cause for concern, given the importance of this decision to an individual's career.

The fields where satisfaction is generally highest include the professions and related programs: education (especially for women), commerce (although a little less so for females than for males, especially in the most recent cohort), engineering and computer science, and other health and life sciences. The next tier of disciplines with medium or more mixed levels of satisfaction includes fine arts

10 The results, except for those from 1984, when it was not asked, are based on the question, "Given your experience...would you have taken the same field of study or specialization?" The answer options were Yes or No. The responses were then built into an index by the author by assigning scores of 100 (for a Yes answer) or 0 (for a No answer). See Finnie (2001; 2000b) for further details.

Table 2: ***Index of Overall Evaluations of Fields of Study, 1982, 1986, and 1990 Cohorts***

	1982 Cohort	1986 Cohort		1990 Cohort	
	1987	1988	1991	1992	1995
			(percent)		
All graduates	71	77	74	72	69
Males					
All fields	73	77	76	74	71
Education	70	78	79	82	76
Fine arts and humanities	74	81	78	72	70
Commerce	82	83	80	77	77
Economics	64	69	64	64	64
Other social sciences	67	64	60	61	55
Agricultural and biological sciences	68	68	69	70	69
Engineering and computer science	76	85	83	84	81
Other health and life sciences	81	90	87	84	80
Mathematics and other physical sciences	69	68	73	67	65
Other fields	83	77	74	71	63
Females					
All fields	69	76	73	71	68
Education	70	83	78	84	77
Fine arts and humanities	71	77	74	68	62
Commerce	78	81	77	73	71
Economics	51	63	61	44	37
Other social sciences	61	68	65	62	61
Agricultural and biological sciences	66	68	65	61	62
Engineering and computer science	78	82	83	82	79
Other health and life sciences	80	82	82	82	79
Mathematics and other physical sciences	71	76	71	69	71
Other fields	72	66	69	69	65

Source: Author's analysis of National Graduates Survey data, as described in the text.

and humanities (except among females in the 1995 cohort), and mathematics and physical sciences in the case of women (but not men). The lowest levels of satisfaction have been for graduates in economics, other social sciences, agricultural and biological sciences, and mathematics and physical sciences — the last of these in the case of men only.

Although the highest approval ratings thus generally went to the disciplines most directly connected to labor market skill sets and relatively clear career paths, the fine arts and humanities graduates, whose fields of study are presumably the polar opposite in this respect, scored in the middle rank, placing them almost uniformly ahead of graduates in the social and the pure and applied sciences. Thus, satisfaction with the educational program is clearly more than a matter of job market preparation — at least for some groups of graduates.

One particularly noteworthy finding is that female economics graduates had the lowest approval scores in all periods; the last cohort in particular had the astoundingly low ratings of just 44 and 37 percent for the two interview dates.[11] That is, almost two-thirds of these graduates said that, given the chance, they would have chosen another field of study. These results give the economics discipline reason to consider their meaning, their underlying causes, and what might be done to improve matters, especially since enrollments in economics have been falling at many institutions in recent years. It is worth noting, meanwhile, that male economics graduates have generally expressed levels of satisfaction similar to those in the other social sciences — although this is not setting the bar particularly high.

The relatively low levels of satisfaction among graduates in the pure and applied sciences might be cause for concern at a broader social level, since the science and technology sectors are critical to the wealth of nations in the new "knowledge-based economy". In particular, these results lead to questions regarding the available career opportunities in these areas (are graduates finding the inter-

11 Standard errors for a comparable set of figures are reported in Finnie (2001).

esting and rewarding jobs they hope for and expect?), as well as the means by which more individuals could be attracted to them.[12]

No clear trends appear in the scores from the first interview to the second for the given cohorts, perhaps implying that graduates have not generally been surprised by how their careers have evolved (at least in relation to their chosen fields of study) subsequent to their initial postgraduation experiences, even though their job outcomes have changed to a considerable degree over this interval (see below).

Neither were there any general shifts in the scores across cohorts (the first and third groups in particular are most directly comparable because they faced similar labor market conditions and rates of further education). These relatively stable satisfaction levels contrast with the popularly held belief that conditions have become increasingly difficult for succeeding cohorts of young people entering the labor market and that opportunities are more limited. While the survey question underlying these evaluation scores is obviously a subjective one, it is quite clearly worded, and any general increases in the dissatisfaction of graduates should probably have shown up in this variable.

Unemployment Rates

Unemployment rates for all graduates taken together have generally been quite low, ranging from 3 to 10 percent across the different interview periods, with similar rates for men and women (see Table 3). Within this range, the rates generally declined quite significantly from two to five years following graduation, from the 8 to 11 percent level down to 3 to 6 percent. The rates again show no clear trend across cohorts; those for the first set of graduates are similar to those for the last.[13]

12 These issues are focused on in Lavoie and Finnie (1999).

13 See Finnie (1999) for further discussion of employment and earnings patterns among graduates by sex and level of education (college, bachelor's, master's, doctorate).

Table 3: ***Unemployment Rates of Graduates by Field of Study, 1982, 1986, and 1990 Cohorts***

	1982 Cohort		1986 Cohort		1990 Cohort	
	1984	1987	1988	1991	1992	1995
			(percent)			
All graduates	9	4	10	6	9	3
Males						
All fields	8	3	11	6	10	3
Education	7	3	5	5	7	3
Fine arts and humanities	15	5	20	5	13	3
Commerce	6	3	7	7	9	3
Economics	9	7	15	9	10	5
Other social sciences	9	4	23	6	13	6
Agricultural and biological sciences	13	6	16	13	15	2
Engineering and computer science	7	2	7	5	6	2
Other health and life sciences	—	0	—	3	7	2
Mathematics and other physical sciences	9	8	7	12	10	4
Other fields	7	—	14	4	10	3
Females						
All fields	9	4	10	6	9	3
Education	11	3	6	7	10	2
Fine arts and humanities	12	5	14	11	10	8
Commerce	6	0	8	5	8	4
Economics	1	0	4	10	6	5
Other social sciences	10	5	13	5	10	3
Agricultural and biological sciences	14	3	17	5	12	3
Engineering and computer science	5	4	4	4	9	0
Other health and life sciences	3	3	2	2	2	2
Mathematics and other physical sciences	6	5	12	3	14	4
Other fields	20	7	16	0	12	7

Note: In this and subsequent tables and figures, the samples also exclude those who had obtained a new diploma by the relevant interview or who were identified as being part-time workers because they were students.

Source: Author's analysis of National Graduates Survey data, as described in the text.

There is significant variation in unemployment rates by discipline, but the patterns are also quite mixed across cohorts, interview years, and sexes, thus making general categorizations rather difficult. Fine arts and humanities graduates experienced rather high unemployment rates as of the first interviews, but, interestingly, much more average rates by the second (especially men). The medium-to-high rates for the pure and applied sciences, as with the program satisfaction measures reported above, are perhaps surprising; the low-to-medium rates among engineering and computer science and other health and life sciences graduates are more as anticipated. The other disciplines are characterized by more mixed rates.

Earnings

The discussion here focuses on the following themes:

- the identification of generally low-, medium- and high-earnings disciplines;
- the evolution of the earnings patterns from two to five years following graduation;
- cross-cohort patterns;
- comparisons of results for males and females;
- the role of intermediary influences (such as labor market experience and personal characteristics) in the discipline effects; and
- differences in the variability of earnings around the regression-based predicted values.

One point worth noting here is that the earnings variable represents the individual's annualized rate of pay. This approach is somewhat unconventional but is appropriate for the purposes of this study as it adjusts for irregular work patterns. (See the Appendix for further details.)

Raw Earnings Patterns

Let us begin with a look at mean earnings by discipline as of each of the two interview dates (also the percentage change in mean

earnings over time) for the three cohorts of male and female graduates (Table 4), and the results of a set of regression models that include only an intercept and the field variables — thus putting the same patterns in a more formal econometric framework (Table 5). (For details on the models presented here and below, see the Appendix.) The field coefficients for this simple model (Model 1) are plotted in Figure 1. Due to the nature of the specifications employed, the coefficient estimates represent the earnings level of each field relative to the average level across all fields (the coefficients sum to unity).

For men, the highest-earnings fields are, in order, other health and life sciences, engineering and computer science, commerce, and mathematics and physical sciences. The low-earnings fields are, from the bottom up, fine arts and humanities, agricultural and biological sciences, and other social sciences. Education and economics have mixed records, but generally lie in the middle of the earnings distribution.

The relative consistency of this ordering across cohorts is interesting — although it is also worth noting that the estimated effects do, in fact, vary to a significant degree from one year to another. For example, the coefficient for engineering and computer science graduates ranges from a low of 0.09 (1988) to a high of 0.21 (1984 and 1992). Thus, the general categorization of the disciplines into those having low, medium, and high earnings is quite consistent, but there is substantial interview-to-interview variation within these broad tendencies.

The earnings patterns for female graduates are relatively similar to those for male graduates, but show some moderate differences in the details. Thus, while the high earnings fields are the same four, their relative standings are somewhat different, with engineering and computer science graduates generally performing even more strongly than was true for men, mathematics and physical sciences graduates also typically doing a little better (except in 1992), and other health and life sciences graduates not doing as well as in the male group. (In this context, recall from Table 1 the very different distributions across these fields between men and women.)

Table 4: ***Mean Earnings of Graduates, by Field of Study, 1982 and 1986 Cohorts***

	1982 Cohort			1986 Cohort		
	1984	1987	% Change	1988	1991	% Change
	(constant 1995 $)			*(constant 1995 $)*		
All graduates	31,100	39,100	26	31,200	38,400	23
Males						
All fields	34,000	43,800	29	33,700	42,100	25
Education	31,100	36,600	18	33,400	38,100	14
Fine arts and humanities	25,900	38,600	49	28,300	35,100	24
Commerce	33,900	44,800	32	34,900	44,400	27
Economics	32,100	45,300	41	32,800	39,600	21
Other social sciences	30,400	41,300	36	29,800	36,200	21
Agricultural and biological sciences	29,400	41,400	41	27,500	39,800	45
Engineering and computer science	38,900	47,000	21	36,200	44,800	24
Other health and life sciences	45,100	62,600	39	47,400	56,700	20
Mathematics and other physical sciences	35,000	46,100	32	33,900	44,700	32
Other fields	30,400	42,600	40	35,100	45,600	30
Females						
All fields	28,300	34,300	21	28,800	34,700	20
Education	27,600	31,900	16	28,700	32,700	14
Fine arts and humanities	23,900	31,000	30	24,200	29,400	21
Commerce	29,400	37,600	28	30,600	39,100	28
Economics	29,100	—	—	32,800	33,700	3
Other social sciences	24,900	31,900	28	26,300	33,200	26
Agricultural and biological sciences	26,500	33,000	25	25,000	32,200	29
Engineering and computer science	36,700	43,600	19	33,600	41,500	24
Other health and life sciences	35,700	38,800	9	35,000	38,000	9
Mathematics and other physical sciences	33,500	42,800	28	32,000	39,700	24
Other fields	26,200	—	—	29,800	35,800	20

Source: Author's analysis of National Graduates Survey data, as described in the text.

Table 5: ***Model 1 — Field Variables Only, 1982, 1986, and 1990 Cohorts***

	1982 Cohort				1986 Cohort				1990 Cohort			
	1984		1987		1988		1991		1992		1995	
	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
Males												
Education	–0.03	0.02	–0.09**	0.03	0.02	0.02	–0.06**	0.02	0.05*	0.03	–0.04	0.02
Fine arts and humanities	–0.26**	0.03	–0.22**	0.03	–0.13**	0.03	–0.21**	0.02	–0.35**	0.03	–0.22**	0.02
Commerce	0.05**	0.02	0.08**	0.02	0.09**	0.02	0.07**	0.02	0.04	0.02	0.05*	0.02
Economics	0.00	0.03	0.09*	0.04	–0.07*	0.03	–0.02	0.03	0.04	0.04	0.05	0.03
Other social sciences	–0.09**	0.02	–0.06*	0.03	–0.05	0.03	–0.08**	0.03	–0.13**	0.02	–0.12**	0.02
Agricultural and biological sciences	–0.12**	0.03	–0.11**	0.04	–0.18**	0.03	–0.11**	0.04	–0.20**	0.04	–0.15**	0.04
Engineering and computer science	0.21**	0.02	0.14**	0.02	0.09**	0.02	0.11**	0.02	0.21**	0.02	0.15**	0.02
Other health and life sciences	0.30**	0.06	0.18**	0.07	0.23**	0.05	0.18**	0.05	0.36**	0.06	0.25**	0.05
Mathematics and physical sciences	0.06*	0.03	0.06	0.03	0.01	0.03	0.07*	0.03	0.02	0.04	0.04	0.04
Other fields	–0.12**	0.05	–0.06	0.07	–0.01	0.04	0.06	0.04	–0.04	0.05	–0.03	0.04
R^2	0.13		0.09		0.06		0.09		0.14		0.09	
Number of observations	2,370		1,904		2,143		2,005		2,235		2,193	

Females												
Education	−0.07**	0.02	−0.10**	0.02	−0.01	0.02	−0.05*	0.02	0.04	0.02	−0.05*	0.02
Fine arts and humanities	−0.24**	0.02	−0.20**	0.03	−0.23**	0.02	−0.16**	0.02	−0.17**	0.03	−0.15**	0.02
Commerce	0.05	0.03	0.07*	0.03	0.06**	0.02	0.12**	0.02	0.08**	0.03	0.04	0.02
Economics	0.00	0.06	0.00	0.06	0.06	0.04	−0.06	0.05	−0.05	0.06	−0.03	0.06
Other social sciences	−0.17**	0.02	−0.05*	0.03	−0.11**	0.02	−0.04	0.02	−0.10**	0.02	−0.10**	0.02
Agricultural and biological sciences	−0.08*	0.04	−0.10*	0.04	−0.18**	0.04	−0.13**	0.05	−0.11**	0.04	−0.09*	0.03
Engineering and computer science	0.26**	0.04	0.22**	0.05	0.13**	0.03	0.20**	0.04	0.21**	0.05	0.19**	0.04
Other health and life sciences	0.24**	0.03	0.07*	0.03	0.18**	0.02	0.09**	0.03	0.26**	0.03	0.13**	0.03
Mathematics and physical sciences	0.15**	0.05	0.18**	0.06	0.07	0.05	0.07	0.06	−0.03	0.05	0.08	0.05
Other fields	−0.14*	0.06	−0.08	0.07	0.03	0.04	0.03	0.05	−0.13**	0.05	−0.02	0.04
R^2	0.12		0.06		0.10		0.05		0.07		0.04	
Number of observations	2,253		1,884		2,432		2,182		2,567		2,545	

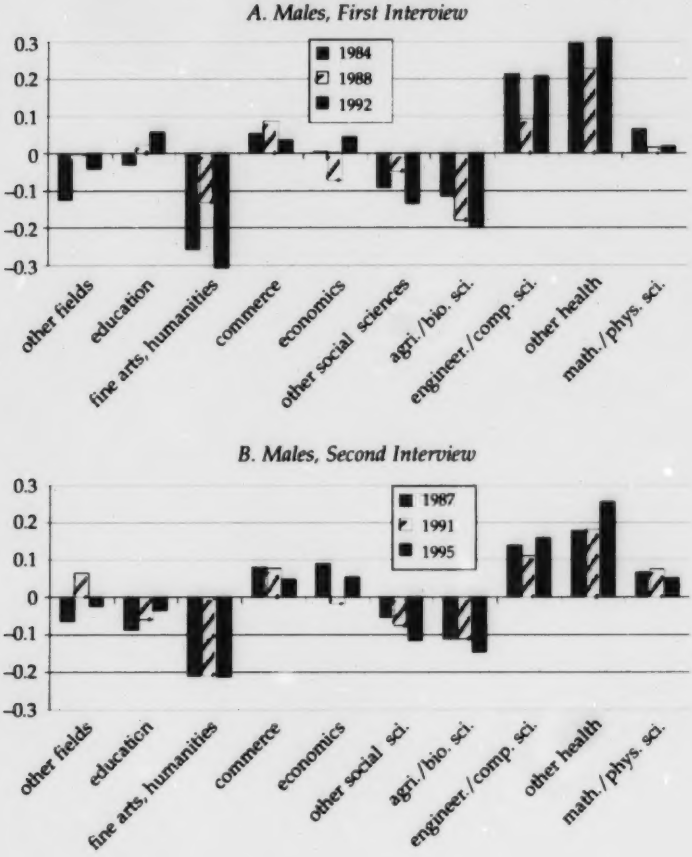
Note: The samples exclude those who were older than age 35 or who had more than five years of full-time experience by the date of graduation.

* Indicates significance at the 0.05 confidence level.

** Indicates significance at the 0.01 confidence level.

Source: Author's analysis of National Graduates Survey data, as described in the text.

Figure 1: ***Coefficient Estimates — Model 1 (Raw Earnings Patterns)***

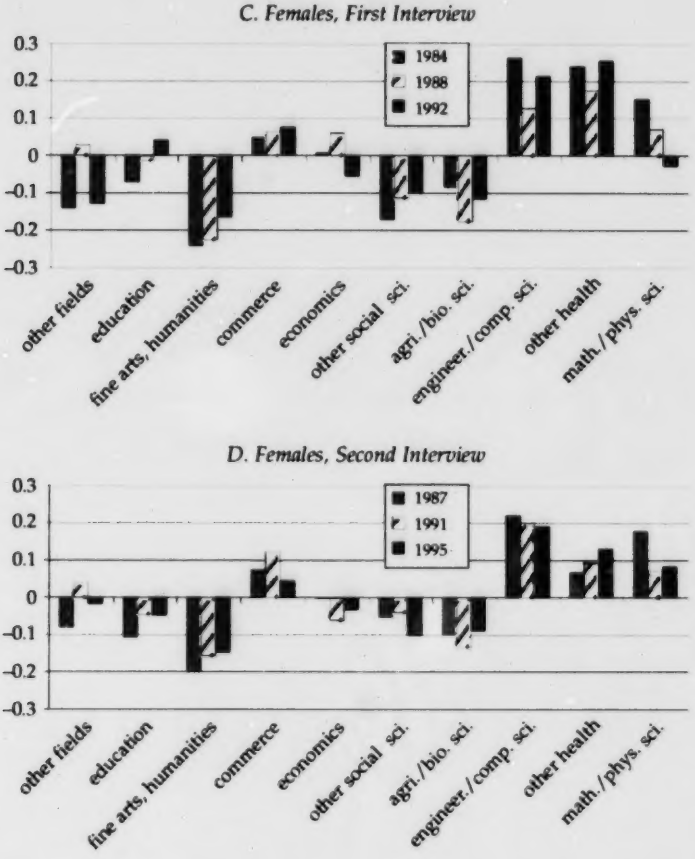


Adjusted Earnings Pattern

The Standard Models

The discipline coefficients generated by the second set of regressions (Model 2), which include a more or less standard set of control variables representing labor market experience, personal

Figure 1 - continued



characteristics, and so on (Table 6 and Figure 2), represent the relevant earnings differences net of any influences that operate through these other variables (for example, certain fields lead to greater full-time employment opportunities).[14]

14 The full model results are reported in Finnie (2000b). See Daymont and Andrisani (1984) for a discussion of the potential endogeneity of certain regressors in such models.

The general ordering of the adjusted field effects is the same for unadjusted earnings: once again, the high-earnings fields are other health and life sciences, engineering and computer science, mathematics and physical sciences, and commerce; the low-earnings fields are fine arts and humanities, other social sciences, and agricultural and biological sciences; education and economics are generally in the middle rank.

Although the effects are smaller than those found in the simple field-only models, they remain quite large — as found by others for the US situation (see, for example, Rumberger and Thomas 1993; Grogger and Eide 1995). The earnings differences typically vary from 30 to 40 log points between the lowest and highest fields, and soar as high as 59 points for male fine arts and humanities versus other health and life sciences graduates in 1992 (coefficients of –30 and .29 respectively). In short, large differences in earnings by field of study remain after controlling for certain standard labor market characteristics and personal attributes.

The two-year versus five-year patterns allow us to plot the evolution of field effects over at least the early part of an individual's career and to begin to identify longer-term profiles. In general, graduates with degrees in education (both males and females) saw their relative earnings levels decline between the two interview dates, falling from around the middle of the pack at two years after graduation to decidedly below average at five years after graduation. Other health and life sciences graduates also saw relative declines; their earnings were among the very highest at the first interview point but they had only a moderate advantage three years later. The initially higher, but subsequently flatter earnings profiles observed for these two groups presumably reflect the effects of these graduates' typically finding employment in highly unionized public and semi-public sectors. (Union status is not, unfortunately, indicated directly in the NGS data.)

Conversely, fine arts and humanities graduates generally experienced relative gains over time, and although they remained among the lowest paid at the five-year point, they were typically not so far behind as they had been two years after graduation (males in the middle cohort are an exception in this regard). This tendency seems to suggest that these typically more generalist graduates

face a more dynamic labor market, with individuals finding interesting job opportunities, gaining promotions, and generally moving ahead in the workplace in the years following graduation. The other disciplines generally showed no consistent change over the interval from two to five years following graduation.

The clearest cross-cohort pattern is that the latest cohort of graduates in the other health and life sciences disciplines enjoyed higher relative earnings than did their earlier counterparts. The other technical and scientific disciplines showed no such improvement; in fact, the cross-cohort movement in many cases was downward. More specifically, both male and female graduates in the third cohort of agricultural and biological sciences and in mathematics and physical sciences had lower relative earnings than those in the first, except for female agricultural and biological sciences graduates at the five-year point, whose earnings held steady. Male engineering and computer science graduates did a little better in the latest cohort (after dipping somewhat in the second), but this was another area of relative decline for female graduates. Overall, there have been no general gains in the more technically and scientifically oriented fields, contrary to what many might have expected.

Other fields that experienced relative earnings gains in the later cohorts were education (both males and females) and fine arts and humanities (females, but not males). General declines occurred for male graduates in other social sciences. For the other disciplines, there are no clear trends across the three cohorts.

Adding Occupation and Industry to the Models

Occupation and industry are fairly highly correlated with, and capture some of the effects of, discipline, and thus these coefficients generate a generally less interesting set of findings. They are, however, worth looking at for the light they cast on how the discipline effects play out in the labor market. Figure 3 plots the coefficients estimated for each of three models (Model 1, including just the field variables; Model 2, including the standard control variables as discussed above; and Model 3, including the occupation and industry variables) averaged over all three cohorts. These graphs

Table 6: ***Model 2 — Adding Basic Control Variables, 1982, 1986, and 1990 Cohorts***

	1982 Cohort				1986 Cohort				1990 Cohort			
	1984		1987		1988		1991		1992		1995	
	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
Males												
Education	0.01	0.02	–0.08**	0.02	0.03	0.02	–0.05*	0.02	0.04	0.02	–0.01	0.02
Fine arts and humanities	–0.20**	0.02	–0.15**	0.03	–0.12**	0.02	–0.14**	0.02	–0.30**	0.02	–0.16**	0.02
Commerce	0.01	0.02	0.06**	0.02	0.07**	0.02	0.06**	0.02	0.03	0.02	0.05**	0.02
Economics	0.00	0.03	0.05	0.03	–0.08**	0.03	–0.06*	0.03	0.02	0.03	0.03	0.03
Other social sciences	–0.07**	0.02	–0.04	0.02	–0.05	0.02	–0.08**	0.02	–0.11**	0.02	–0.13**	0.02
Agricultural and biological sciences	–0.09**	0.03	–0.08*	0.03	–0.15**	0.03	–0.10**	0.03	–0.14**	0.03	–0.14**	0.03
Engineering and computer science	0.15**	0.02	0.10**	0.02	0.08**	0.02	0.09**	0.02	0.17**	0.02	0.14**	0.02
Other health and life sciences	0.20**	0.05	0.13*	0.06	0.20**	0.05	0.17**	0.05	0.29**	0.05	0.21**	0.05
Mathematics and physical sciences	0.07*	0.03	0.07*	0.03	0.03	0.03	0.06*	0.03	0.03	0.03	0.05	0.03
Other fields	–0.08	0.04	–0.05	0.06	0.00	0.03	0.05	0.03	–0.02	0.04	–0.04	0.04
R^2	0.35		0.29		0.24		0.29		0.36		0.30	
Number of observations	2,370		1,904		2,143		2,005		2,235		2,193	

Females												
Education	–0.01	0.02	–0.05*	0.02	0.02	0.02	–0.01	0.02	0.04*	0.02	–0.03	0.02
Fine arts and humanities	–0.19**	0.02	–0.17**	0.02	–0.19**	0.02	–0.14**	0.02	–0.13**	0.02	–0.09**	0.02
Commerce	0.00	0.02	0.04	0.03	0.03	0.02	0.09**	0.02	0.04	0.02	0.01	0.02
Economics	–0.02	0.05	–0.02	0.05	0.06	0.04	–0.12**	0.04	–0.06	0.05	–0.10*	0.05
Other social sciences	–0.16**	0.02	–0.06**	0.02	–0.12**	0.02	–0.04*	0.02	–0.07**	0.02	–0.07**	0.02
Agricultural and biological sciences	–0.03	0.03	–0.08*	0.04	–0.15**	0.03	–0.10**	0.04	–0.13**	0.03	–0.07*	0.03
Engineering and computer science	0.18**	0.04	0.17**	0.04	0.09**	0.03	0.15**	0.03	0.15**	0.04	0.13**	0.04
Other health and life sciences	0.17**	0.02	0.08**	0.03	0.17**	0.02	0.13**	0.02	0.24**	0.03	0.16**	0.02
Mathematics and physical sciences	0.12**	0.04	0.12**	0.05	0.06	0.04	0.05	0.05	–0.01	0.05	0.06	0.04
Other fields	–0.05	0.05	–0.03	0.06	0.02	0.04	0.06	0.05	–0.09*	0.04	0.01	0.04
R^2	0.38		0.35		0.31		0.38		0.33		0.36	
Number of observations	2,253		1,884		2,432		2,182		2,567		2,545	

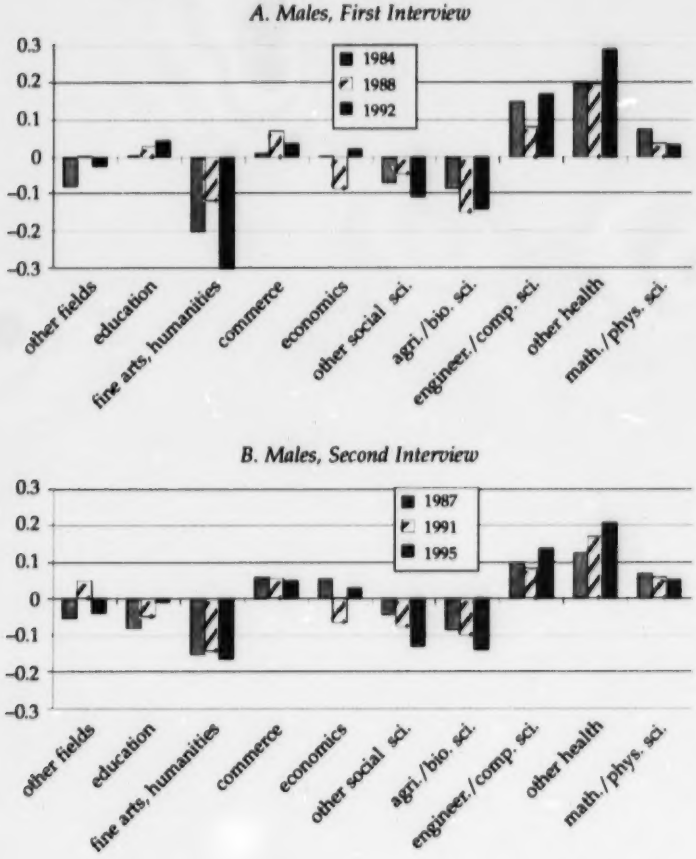
Note: The samples exclude those who were older than age 35 or who had more than five years of full–time experience by the date of graduation. The model includes controls for pre–program educational level, age, postgraduation experience, self–employment status, marriage/children, region, and language.

* Indicates significance at the 0.05 confidence level.

** Indicates significance at the 0.01 confidence level.

Source: Author's analysis of National Graduates Survey data, as described in the text.

Figure 2: ***Coefficient Estimates — Model 2 (Adding Basic Control Variables)***

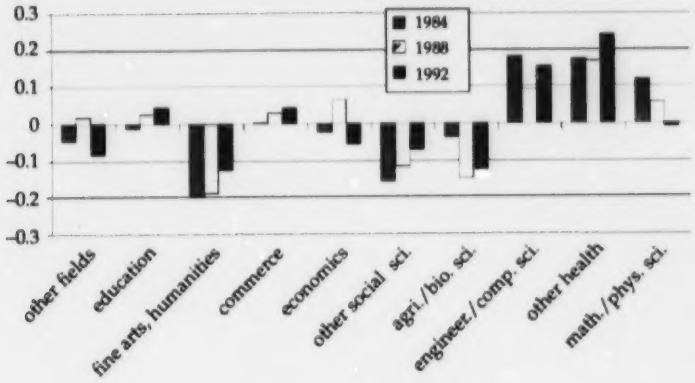


thus show the average effects (across all the cohorts) on the discipline coefficients of adding the two groups of control variables to the specification — which, in fact, accurately represent the findings for the three models for each of the cohorts individually, as reported in Finnie (2000b).[15]

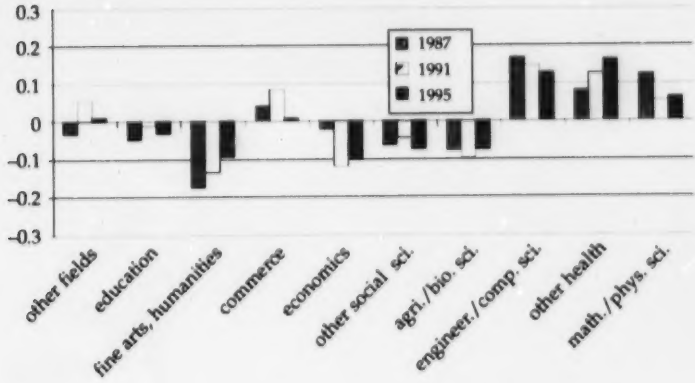
15 That is, the coefficients shown in Figure 3 represent the arithmetic means of the estimated coefficients of the simple fields-only earnings models across the...

Figure 2 - continued

C. Females, First Interview



D. Females, Second Interview

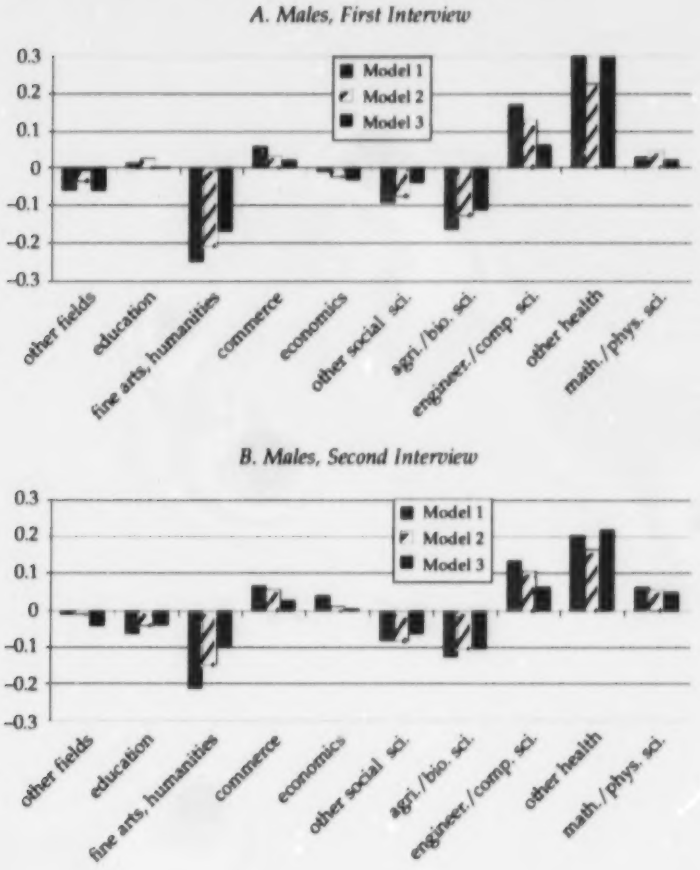


Adding the additional control variables is seen to generally — but not uniformly — reduce the (net) field effects in the case of both men and women. That is, the high-earnings disciplines are

Note 15 - cont'd.

three cohorts (Model 1), the means of the models with the basic set of controls included (Model 2) across the three cohorts, and the means of the coefficients generated by the models that include occupation and industry (Model 3) across the three cohorts.

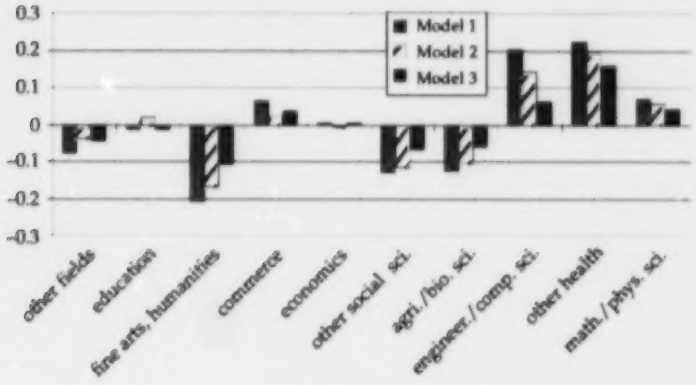
Figure 3: ***Means Coefficient (All Three Cohorts), by Model***



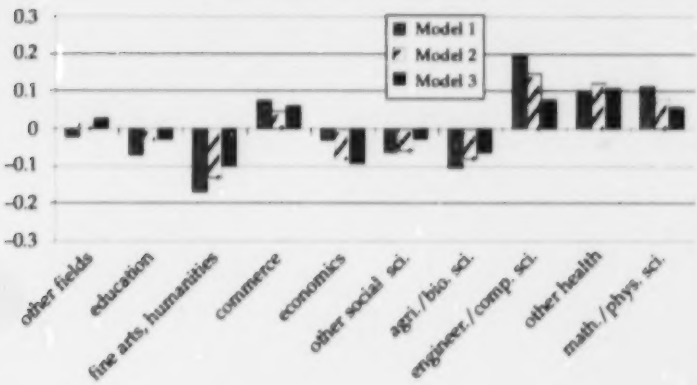
not quite as high when the controls are added, the low-earnings fields are not as low, and so on. The only really notable exception is the other health and life sciences category in the case of men, where adding occupation and industry to the models actually increases its net advantage, suggesting that such graduates have tended to find employment in occupations and industries that are generally lower paying (for men). Economics is also of some interest since, in three of the four cases (excepting only female gradu-

Figure 3 - continued

C. Females, First Interview



D. Females, Second Interview



ates two years after graduation), the coefficients become moderately less positive or more negative when the extra controls are added. This result indicates that the middle-rank earnings levels of economics graduates are due to their having moderately "high-earning" labor market and persona! attributes (especially in terms of the broad occupational and industrial groups in which they find employment), as seen in the fact that their earnings were actually below average once such factors are taken into account. An eco-

nomics degree thus appears to get graduates into well-paying occupational environments but in which they are the somewhat poorer cousins.

The (Unexplained) Variation in Earnings by Discipline

We now look at the intradiscipline variance of earnings based on the difference between individuals' predicted and actual levels. The mean absolute differences by discipline based on the Model 2 regression specifications reported in Table 7 and Figure 4 thus represent the (approximate) "average error" by discipline in percentage terms.[16] To the degree that the regression models reflect individuals' estimates of their future earnings, this measure also represents the extent of uncertainty of future earnings for a typical graduate entering a given discipline.[17]

Whereas we would expect some disciplines to have smaller deviations from their predicted values simply because they represent more narrowly defined fields (for example, economics and perhaps agricultural and biological sciences), other comparisons can be made across categories representing discipline groups that are more evenly defined in terms of the different number and varying nature of the fields included. It is also interesting to note where the small-versus-large comparisons do not appear to follow a simple "aggregation rule."

Over all disciplines, actual earnings deviate from the regression-predicted levels by averages of 21 to 26 percent across the different survey years for men, and by 23 to 27 percent in the case of women. Interestingly, there are no clear trends in the extent of these errors from two to five years following graduation or in the cross-cohort patterns, except that the second-cohort errors are slightly smaller

16 The results for the models with occupation and industry included are reported in Finnie (2000b).

17 Other measures of variability could, of course, have been employed, but this "average error" has a nice intuitive interpretation while generally serving the purposes of the analysis.

Table 7: *Model 2 — Mean Absolute Errors, by Field of Study*

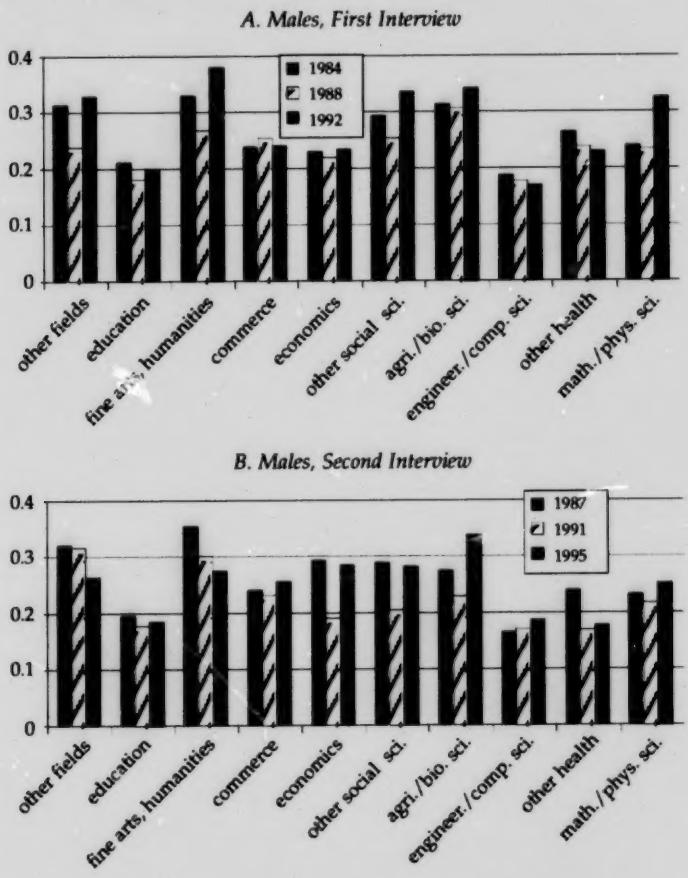
	1982 Cohort		1986 Cohort		1990 Cohort	
	1984	1987	1988	1991	1992	1995
			(dollars)			
Males						
All fields	0.24	0.24	0.22	0.21	0.26	0.24
Education	0.21	0.19	0.18	0.18	0.20	0.18
Fine arts and humanities	0.33	0.36	0.27	0.30	0.38	0.27
Commerce	0.24	0.24	0.25	0.23	0.24	0.25
Economics	0.23	0.29	0.22	0.19	0.23	0.28
Other social sciences	0.29	0.29	0.25	0.20	0.34	0.28
Agricultural and biological sciences	0.31	0.27*	0.31	0.23	0.34	0.34
Engineering and computer science	0.18	0.17	0.18	0.17	0.17	0.18
Other health and life sciences	0.26*	0.24*	0.24*	0.17	0.23*	0.18
Mathematics and physical sciences	0.24	0.23	0.23	0.21	0.32	0.25
Other fields	0.31*	0.32*	0.24	0.31*	0.33*	0.26
Females						
All fields	0.26	0.26	0.23	0.24	0.27	0.24
Education	0.29	0.27	0.23	0.23	0.23	0.23
Fine arts and humanities	0.32	0.32	0.26	0.30	0.32	0.27
Commerce	0.20	0.23	0.18	0.23	0.23	0.23
Economics	0.24*	0.24	0.28*	0.27	0.30*	0.33*
Other social sciences	0.28	0.26	0.28	0.26	0.30	0.26
Agricultural and biological sciences	0.26	0.24	0.26	0.27	0.32	0.27
Engineering and computer science	0.20	0.21	0.22	0.15	0.22	0.20
Other health and life sciences	0.15	0.21	0.17	0.20	0.20	0.19
Mathematics and physical sciences	0.23	0.25*	0.22	0.28*	0.32*	0.24
Other fields	0.25*	0.25*	0.19	0.23*	0.37*	0.28

Note: Mean absolute errors are calculated as the mean absolute difference between actual log earnings and their predicted values (based on the regression estimates) for the individuals of each field.

* Indicates a standard error between 0.01 and 0.02. Other means have standard errors below 0.1.

Source: Author's analysis of National Graduates Survey data, as described in the text.

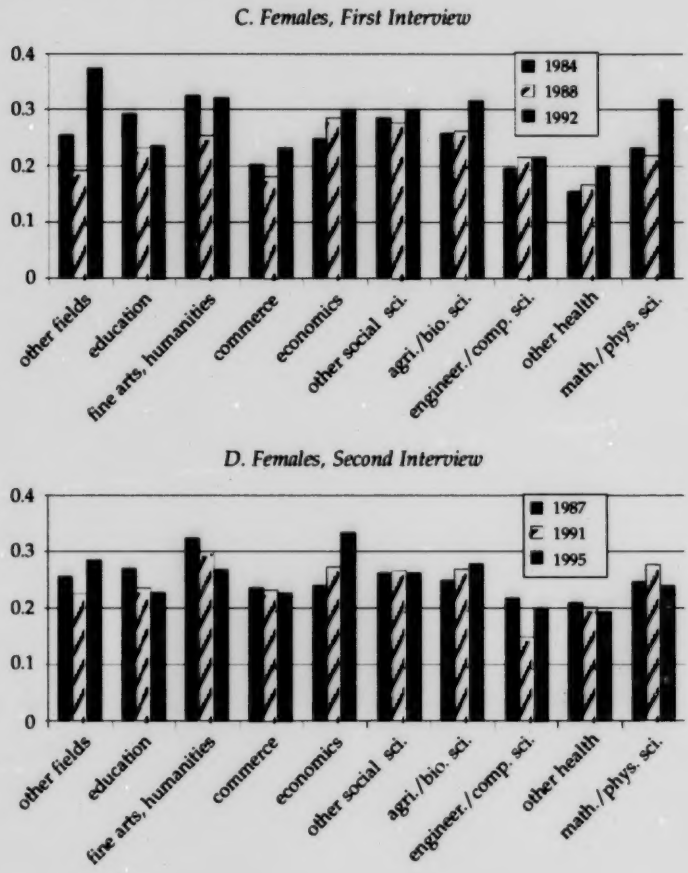
Figure 4: ***Mean Absolute Errors, by Field of Study — Model 2***



than those of the first and last. Thus, while many observers talk of labor markets having become more uncertain and outcomes more polarized, the numbers do not seem to support this hypothesis in the case of bachelor's-level graduates — at least as measured in this manner.

The most notable outcome in terms of disciplines is probably the relatively low percentage errors that characterize engineering and computer science graduates, especially for men. These low

Figure 4 - continued



errors presumably indicate that these disciplines boast relatively homogenous groups of graduates who face well-structured job markets. Other health and life sciences disciplines, especially in the case of women, also have relatively well-predicted earnings values, as do male education graduates — again, presumably reflecting a relative homogeneity of graduates and their typically finding jobs in highly unionized sectors with standardized wage scales. At the other extreme, fine arts and humanities graduates tend to have the

greatest variation in earnings around the regression-based predicted values — presumably reflecting the heterogeneity of graduates characterizing this broad area and the commensurate variation in earnings opportunities and preferences. Of perhaps greater surprise is the fact that the single field of economics is characterized by prediction errors in the middle rank, whereas one might have expected smaller errors from such a relatively uniform group of graduates; the wide range of labor opportunities realized by economics graduates (from Bay Street to bank clerks) is apparent in these numbers.

Conclusions

The principal findings of this analysis of differences in earnings by discipline among bachelor's-level university graduates in Canada may be summarized as follows.

First, there are still significant differences in the distribution of graduates by sex, and there was surprisingly little change in the distribution of graduates across disciplines for either sex for the three cohorts that finished their schooling in 1982, 1986, and 1990.

Second, there are important differences in earnings by discipline, consistent over time and, in many cases, large. The highest-earnings fields are other health and life sciences, engineering and computer science, commerce, and mathematics and physical sciences; the low-earnings fields are fine arts and humanities, agricultural and biological sciences, and other social sciences. Education and economics are generally in the middle of the earnings distribution.

Adding two different sets of control variables to the models typically reduces the (net) field effects, but the general ordering persists across the various specifications. The effects of discipline on earnings thus appear to operate to some degree through the accumulation of greater labor market experience and other work-related characteristics (including occupation and industry), and are also perhaps associated with certain personal attributes that affect earnings; significant discipline effects remain, however, even after controlling for these influences.

The general ordering of the earnings differences by discipline is relatively consistent for both male and female graduates for the

two-year and five-year interview points and for the three cohorts of graduates, although tests not shown indicate that the differences are, in fact, statistically significant along all these dimensions — hence the estimation of the different models shown.

One finding particularly worth mentioning is that there was no general improvement in the earnings of science and technology graduates (the exception being other health and life sciences workers) — a somewhat surprising result, since these fields are typically cited as being critical to the knowledge-based economy and students are often urged to enter these areas for the benefit of their own careers, as well as the sake of the country's economic performance. The general, though moderate, declines in the relative earnings of pure and applied science graduates over this period are especially noteworthy in this regard, as are the continued (relative) low earnings levels of graduates in the applied sciences.

Finally, the measure of the difference between individuals' actual earnings levels and those predicted by the regression models indicates that, overall, these "average errors" were relatively constant across cohorts, suggesting that labor market outcomes have not necessarily become more variable or uncertain among bachelor's-level university graduates over the period covered by this analysis. Graduates in engineering and computer science as well as in other health and life sciences tended to have earnings levels that are more accurately predicted by the regression models, while the greatest (conditional) variation in earnings — that is, earnings uncertainty — has been among fine arts and humanities graduates.

Implications of the Findings

There are various reasons earnings might differ by field of study. First, exogenous shifts in demand or supply (driven by factors such as changes in technology or the greater opening of the economy to global forces, or demographic shifts) will have at least short-run effects on relative earnings patterns, and such effects should be greatest for those, such as recent graduates, who are just entering the labor market and thus at its margins. Second, compensating differentials generate more enduring earnings differences by discipline; the underlying factors include the time and effort required at

school and on the job, the degree of stress or level of responsibility, the uncertainty of outcomes, offsetting perquisites, and so on. Third (and related), longer-term ("equilibrium") earnings differences tend to arise in the face of any general scarcity of skills — for example, engineers and other more technically oriented workers might be higher paid if there are a limited number of individuals with the technical abilities required to enter the discipline. Fourth, more artificial supply-side constraints could exist, perhaps reflecting the structure and behavior of the postsecondary system itself (for example, limited admission to certain programs), the actions of associated professional associations (such as the exams required for certification in certain professions), and other institutional influences. Finally, a wide range of government policies could affect earnings patterns by discipline, including those relating to education (for example, subsidies to enter some fields and not others), the labor market (measures that shift the relative costs or benefits associated with different occupations), and others.

One interesting aspect of the findings is the lack of change in the distribution of majors despite the large earnings differences between them. One potential explanation is that the observed mean differences in returns reflect differences in average ability and that the marginal earnings for a person of a given ability are, in fact, the same across majors. If this is the case, the unchanging distribution of persons across majors is not a puzzle because, at the margin, no one has an incentive to move, and the earnings differences represent the sort of skill premiums described above. A similar conclusion would hold in the face of other "equilibrium" explanations, such as compensating differentials.

Alternatively, the stability of the distribution of graduates could stem from rigidities on the supply side. Universities, in particular, have perhaps not been responsive to the need for different types of graduates (as reflected in the observed earnings differentials by discipline). In short, universities may not have been meeting students' preferences and the underlying (relative) demand for graduates of different disciplines, instead continuing to produce the same types of graduates as in the past. Any such rigidities could be the result of blockages in the university system, where, for example, each institution is stuck with a given number of tenured

professors, or where interdepartmental "turf battles" for resources are based on internal power structures rather than on the number of students queuing up.

From another perspective, the relative stability of earnings patterns by discipline across the different cohorts of graduates reported above suggests that the forces that determine these patterns have been relatively steady over time in Canada, at least as they apply to the recent bachelor's-level graduates treated here. For all the talk of the manner in which the Canadian economy is generally reorienting toward science and technology, of "globalization," of the emergence of the "knowledge-based economy," of the "polarization" of earnings levels, and so on, earnings patterns have, in fact, remained remarkably stable — as has the distribution of graduates. Furthermore, these two patterns are presumably related — if individuals are, in fact, able to move toward disciplines with higher and/or increasing earnings. Interestingly, the shifts that are observed — declines in the relative earnings of certain science graduates, in particular — seem to go in the opposite direction of what one might have predicted. Furthermore, these dynamics differ from the US experience.[18]

One interpretation of these findings is, therefore, that the underlying forces of supply and demand have been remarkably — indeed, surprisingly — stable over this period. This would, in turn, suggest that the Canadian labor market has, in fact, not been moving as strongly in the suspected directions as many think. That is, neither relative earnings patterns nor numbers of graduates have shifted because the economic forces that tend to drive such adjustments simply have not been present.

---

18 In some US studies (for example, Berger 1988; Eide 1994; Grubb 1992; and Hecker 1995), earnings and enrollment differences by major — as well as the effects of these differences on male/female earnings patterns, the rate of return to college, or shifts in earnings patterns over time — are the particular focus of the analysis. In others (for example, Daniel, Black, and Smith 1999; Datcher Loury and Garman 1995; Daymont and Andrisani 1984; Grogger and Eide 1995; Grubb 1993; Jones and Jackson 1990; and Rumberger and Thomas 1993), discipline effects are considered along with other education-related factors, such as school quality/selection, performance (grades), curriculum (specific courses taken), and ability (test scores), that affect earnings.

An alternative interpretation is that the Canadian economy might indeed be evolving as suspected, but that this change has not resulted in any significant shifts in earnings patterns (at least for recent graduates) or, correspondingly, in the relative numbers of graduates. Such wage rigidity would be surprising, and certainly worthy of further investigation, as would the lack of much response on the part of universities to such changing economic circumstances.

In short, the observed stability of the relative earnings of graduates of different disciplines and the numbers of graduates is surprising, especially as it contrasts with US experience. Has the Canadian economy simply been more stable? Does the Canadian experience reflect greater labor market rigidities? Is Canada's university system less responsive to changing job opportunities (and students' preferences) than it should be? Answering such questions would be a natural path for future research.

The relative consistency of earnings by discipline from the first to the second interviews is also interesting, as it suggests that the above-mentioned forces are fairly constant: high- (and low-) earnings fields tend to be so throughout at least the early part of graduates' careers. Nonetheless, the observed shifts point to the existence of some significant differences in the slope of graduates' age-earnings profiles by discipline, and the discipline effects are generally statistically different at the two interview points.

In fact, these findings point, first of all, to the need to look beyond initial postgraduation outcomes to get a proper understanding of how earnings compare in the longer run. In particular, fine arts and humanities graduates did some significant catching up to the better-paying disciplines from two to five years following graduation, indicating that they face a generally more dynamic labor market, characterized by more improved job opportunities and greater earnings growth than other graduates. This might, furthermore, help explain the finding that fine arts and humanities students are relatively satisfied with their choice of discipline — beyond what might have been expected from looking at initial labor market outcomes alone.

These results also have direct implications for the interpretation of previous studies in which the differences in earnings by dis-

cipline are estimated across all age cohorts, or at different points in time following graduation; there are important differences in earnings patterns along these dimensions that such studies miss.

The general similarity of the earnings patterns by discipline for the two sexes is also noteworthy, although there are some moderate differences in this regard. Meanwhile, the very large differences in the distribution of graduates across disciplines by sex, which are largely unchanged across the three cohorts of graduates, remain an intriguing aspect of earnings patterns and labor market behavior more generally — especially, perhaps, when the relative earnings patterns are similar.

Unobserved Ability

Unobserved ability clearly plays an important role in the earnings patterns analyzed here. The higher-earnings disciplines unquestionably are capturing innate characteristics such as general intelligence, specific skills, perseverance, and so on, as well as the effects of the chosen field of study *per se*.

While the patterns reported here are still of interest for the reasons cited at the beginning of this paper, one important implication of the missing ability factor is that "extra" or marginal graduates would not necessarily be expected to have the earnings levels reported here. For example, while one might argue that it is good public policy to increase enrollment in engineering and computer science programs, the additional places created presumably would be filled by individuals with lower average ability than past graduates in these disciplines, and earnings — and the labor market productivity those earnings are usually assumed to represent — of these marginal graduates would be commensurately lower as well.

This is the classic problem characterizing the literature on earnings patterns by discipline, and this paper offers no special treatment in this respect; in fact, it suffers from the lack of any sort of ability measures at all, including those of the types that have been used in US work. Future Canadian databases, including the Youth in Transition Survey (which will track various waves of young people from their middle and late teens and early twenties over time), might offer some interesting opportunities in this regard.

Other Paths for Future Research

One promising possibility for future research is a similar analysis at a more detailed level for selected disciplines, to see if the aggregate-level findings reported here — relative stability of the patterns by cohort, by year relative to graduation, by sex, and so on — hold up. It might also be interesting to see how the "average error" measure behaves at a more detailed level, and if there are the sorts of tradeoffs across disciplines in terms of the average level and variance of earnings that theory predicts.

Another potential avenue of research is to look at earnings at a later point in time following graduation to see how patterns evolve over the longer run. But work of this type would have to await another follow-up survey of one of the NGS cohorts already interviewed, which Statistics Canada is not currently planning, or other data.

Finally, building from the preceding discussion of unobserved ability, it would be extremely interesting to model the choice of discipline, both for its own sake and as the first stage of a broader model that controlled for the related selection dynamics and associated omitted heterogeneity in the estimation of differences in earnings by discipline. This task, however, would not only be fairly complex from a theoretical econometric perspective, but on a practical level it would probably lie beyond the capacity of at least the NGS data used here, which suffer from a relative paucity of the sorts of background variables that could be used to identify the necessary structural relationships (that is, variables that affect the choice of discipline but have no direct effect on earnings).[19]

In the meantime, the estimates reported here represent a useful descriptive analysis of earnings differences by discipline, providing a set of benchmark estimates of the earnings differences by field of study that have existed for Canadian graduates over the past decade and a half and an empirical footing for various policy discussions.

19 See Altonji (1993) for a model of the choice of the number of years of study with certain endogenous regressors, including discipline; Garen (1984) for an earlier piece in the same spirit; and Coté and Sweetman (1997) for an attempt to model the differences in earnings by discipline with the choice of discipline treated as a choice outcome, but with limited success due to the questionable nature of the instruments employed.

Appendix: The Earnings Models

The primary objective of this paper is to estimate the differences in labor market earnings by field of study of recent postsecondary graduates at two specific points in time after leaving school corresponding to the interview dates of the National Graduates Survey data. The standard approach is to estimate earnings models that include indicators of a graduate's discipline while controlling for various other influences. The models used here conform to these conventions as adapted to the postgraduation period covered and the information available in the NGS databases. The specific variables included in the models are described below.

One innovation offered here is the imposition of restrictions on the parameter estimates that force the field-of-study coefficients to be expressed relative to the (conditional) mean. In the more usual approach, one discipline is used as the (omitted) baseline against which other field effects are measured, meaning that various pairwise comparisons are required to gauge the effects of any specific discipline relative to the others. Furthermore, the estimated effects shift with the earnings of the baseline group, rendering cross-year and cross-sex comparisons particularly complex — for example, a decrease in the relative earnings of the baseline group will cause all other coefficients to rise. The approach adopted here thus allows for a more straightforward and robust "relative to the average" interpretation of the estimated field effects.

The models are estimated separately for men and women for each of the six interview dates (two and five years following graduation for each of three cohorts). This disaggregated approach was adopted after conventional tests indicated that the structure of earnings was sufficiently different for the two interview points within a given cohort, for the three different cohorts, and for both sexes to require the estimation of separate models along each of these dimensions. The same logic holds for the discipline effects themselves: pooling was rejected even after allowing all nondiscipline parameters to vary freely across interview dates (and sex), indicating in a formal fashion that the differences in earnings by field of study vary significantly between the two interview points, across cohorts, and by sex — an interesting result to begin with,

and one with potential relevance for other studies where such poolings are imposed.

The earnings variable available on the NGS databases is based on the question: "Working your usual number of hours, approximately what would be your annual earnings before taxes and deductions at that job?" It thus represents what the graduate would earn (before deductions) on an annual basis if the job he or she held at the time of the interview lasted the full year, regardless of the actual number of weeks worked. In adjusting for irregular work patterns in this manner, the measure represents the individual's rate of pay on an annual basis rather than the amount earned. It is a somewhat unconventional measure but embodies a relatively well-defined and analytically appropriate concept and suits the purposes of this study. All earnings values are expressed here in constant 1995 dollars, and in the NGS data are rounded to the nearest thousand and capped at the $99,000 upper limit that characterizes the 1984 data (the lowest bound in the six databases), or $143,035 in constant 1995 dollars.

Standard practice is followed by using the natural log of earnings as the dependent variable, thus allowing the coefficient estimates to be interpreted in (approximate) percentage terms. Three models are specified: Model 1 includes no regressors except for the field-of-study indicators, and thus reveals the "raw" earnings differentials by discipline in a formal regression framework. Model 2 includes the variables listed below representing labor market experience, previously held degrees, and personal characteristics, thereby yielding the earnings differences by field that hold after controlling for these factors. Model 3 adds dummy variables representing the individual's occupation and industry, but since these variables are fairly strongly correlated with field of study and undoubtedly pick up some of the discipline effects, the discussion of these findings is relatively brief.

The variables included in Models 2 and 3 are:

- other degrees — a dummy variable indicating that the individual held a higher degree (master's or doctorate) before entering the bachelor's program;

- age and age squared — note also the sample restriction to individuals under age 35 at graduation (as discussed in the text);
- postgraduation work experience — proxied in the first interview regressions with part-time and full-time employment status as of two specific dates between graduation and the first interview (the October in the following year and the January after that), and in the second interview regressions with the addition of employment status as of the first interview (more conventional experience variables reflecting the total time working are not available in the NGS databases); tenure with the current employer was excluded on the grounds that it could capture some of the effects that properly belong to the discipline studied;
- part-time work — the standard definition (30 hours), to control for individuals' labor supply decisions;
- self-employment — a standard dummy variable indicator (as opposed to being a paid worker);
- marital status/presence of children — standard indicators that, in this case, allow for the effects of children to vary by marital status: single (never married) with/without children; married with/without children; and widowed, separated, or divorced with/without children;
- province/language — allows for provincial and regional effects (the Atlantic provinces, Quebec, Ontario, Manitoba and Saskatchewan, Alberta, British Columbia, and the territories) plus minority language effects (anglophone in Quebec, francophone outside of Quebec, other language);
- industry — 13 standard industrial sectors;
- occupation — 15 standard occupational groups

See Finnie (2000b) for further discussion of the data and the econometric approach employed here.

References

Altonji, Joseph G. 1993. "The Demand for and Return to Education When Outcomes Are Uncertain." *Journal of Labor Economics* 11 (1): 48–83.

———. 1995. "The Effects of High School Curriculum on Educational and Labor Market Outcomes." *Journal of Human Resources* 30 (3): 39–44.

Berger, Mark C. 1988. "Cohort Size Effects on Earnings: Differences by College Major." *Economics of Education Review* 7 (4): 375–383.

Betts, Julian, Chris Ferrall, and Ross Finnie. 1999. "The Effects of School Quality on Bachelor's Graduates' Earnings." Paper presented at the American Education Research Association Meetings, Montreal, April.

Cohn, Elchanan. 1997. "Rates of Return to Schooling in Canada." *Journal of Education Finance* 23 (2): 193–206.

Côté, Sylvain, and Arthur Sweetman. 1997. "Does It Matter What I Study? Post-Secondary Field of Study and Labor Market Outcomes in Canada." University of Victoria. Unpublished.

Daniel, Kermit, Dan Black, and Jeffrey Smith. 1999. "College Quality and the Wages of Young Men." Paper presented at the American Education Research Association Meetings, Montreal, April.

Datcher Loury, Linda, and David Garman. 1995. "College Selectivity and Earnings." *Journal of Labor Economics* 13 (2): 289–308.

Daymont, Thomas A., and Paul J. Andrisani. 1984. "Job Preferences, College Major, and the Gender Gap in Earnings." *Journal of Human Resources* 19 (3): 408–428.

Dodge, David, and David A.A. Stager. 1972. "Economic Returns to Graduate Study in Science, Engineering and Business." *Canadian Journal of Economics* 5 (2): 182–198.

Eide, Eric. 1994. "College Major Choice and Changes in the Gender Wage Gap." *Contemporary Economic Policy* 12 (April): 55–64.

Finnie, Ross. 1995. "Steppin' Out: An Analysis of Recent University Graduates into the Labour Market." Industry Canada Working Paper 5. Ottawa: Industry Canada.

———. 1999. "Holding Their Own [1999]: Recent Trends in the Employment Rates and Earnings Levels of Post-Secondary Graduates." *Canadian Business Economics* 7 (4): 48–64.

———. 2000a. "From School to Work: The Evolution of Early Labour Market Outcomes of Canadian Post-Secondary Graduates." *Canadian Public Policy* 26 (2): 197–224.

———. 2000b. "What You Study Matters: An Econometric Analysis of Earnings Differences by Field of Study amongst Recent Canadian Bachelor's Level University Graduates." Human Resources Development Canada working paper. Ottawa: Human Resources Development Canada, Applied Research Branch.

———. 2001. "Fields of Plenty, Fields of Lean: the Early Labour Market Outcomes of Canadian University Graduates." *Canadian Journal of Higher Education* 31 (1): 141–176.

———, and Marc Frenette. Forthcoming. "Earnings Differences by Major Field of Study: Evidence from Three Cohorts of Recent Canadian Graduates." *Economics of Education Review*.

———, and Ted Wannell. 1999. "The Gender Earnings Gap amongst Canadian Bachelor's Level University Graduates: A Cross-Cohort, Longitudinal Analysis." In Richard Chaykowski and Lisa Powell, eds., *Women and Work*. Kingston, Ont.; Montreal: McGill/Queen's University Press.

Garen, John. 1984. "The Returns to Schooling: A Selectivity Bias Approach with a Continuous Choice Variable." *Econometrica* 52 (5): 1199–1218.

Grogger, Jeff, and Eric Eide. 1995. "Changes in the College Skills and the Rise in the College Wage Premium." *Journal of Human Resources* 30 (2): 280–310.

Grubb, W. Norton. 1992 "The Economic Returns to Baccalaureate Degrees: New Evidence from the Class of 1972." *Review of Higher Education* 15 (2): 213–231.

———. 1993. "The Varied Economic Returns to Postsecondary Education: New Evidence from the Class of 1972." *Journal of Human Resources* 28 (2): 365–381.

Hecker, Daniel E. 1995. "Earnings of College Graduates, 1993." *Monthly Labor Review*, December, pp. 3–16.

Jones, Ethel B., and John D. Jackson. 1990. "College Grades and Labor Market Rewards." *Journal of Human Resources* 25 (2): 253–266.

Lavoie, Marie, and Ross Finnie. 1999. "Is It Worth Doing a Science or Technology Degree in Canada? Empirical Evidence and Policy Implications." *Canadian Public Policy* 25 (1): 101–121.

Mehmet, Ozay. 1977. "Economic Returns on Undergraduate Fields of Study in Canadian Universities: 1961 to 1972." *Industrial Relations* 32 (3): 321–339.

Murphy, Kevin M., and Finis Welch. 1990. "Empirical Age-Earnings Profiles." *Journal of Labor Economics* 8 (April): 202–229.

Rumberger, Russell, and Scott L. Thomas. 1993. "The Economic Returns to College Major, Quality and Performance: A Multilevel Analysis of Graduates." *Economics of Education Review* 12 (1): 1–19.

Stager, David. 1996. "Returns to Investment in Ontario University Education, 1960–1990, and Implications for Tuition Fee Policy." *Canadian Journal of Education* 26 (2): 1–21.

Turner, Sarah E., and William G. Bowen. 1999. "Choice of Major: The Changing (Unchanging) Gender Gap." *Industrial and Labor Relations Review* 52 (2): 289–313.

Vaillancourt, François. 1995. "The Private and Total Returns to Education in Canada, 1985." *Canadian Journal of Economics* 28 (3): 532–553.

The Returns to University Education in Canada, 1990 and 1995

François Vaillancourt and
Sandrine Bourdeau-Primeau

The purpose of this paper is to present new, comparable estimates of the 1990 and 1995 private and total rates of return to university education in Canada. The calculation is by level of schooling and, for bachelor's degrees, by field of study.

These findings should be of interest to those working in higher education because the rates of return to schooling are used, at least implicitly, in allocating resources. Private decisionmakers — individuals faced with the choice of pursuing further education, such as college or university level studies (or funding such studies as parents) or of entering the labor force — want to know if further studies are associated with monetary returns. Public decisionmakers, who face competing demands for scarce funds from the education sector and other sectors of society and, within the education sector, from various postsecondary programs, may want to use total rates of return to guide, in part, their spending decisions.

The paper is divided into three parts. The first one reviews the recent literature, and the second presents an analytical framework, assumptions, data sources, and the calculations made with them. The third analyzes the results and draws some conclusions.

Research results reported in this paper were prepared using funding from the Social Sciences and Humanities Research Council of Canada and Human Resources Development Canada. We thank David Laidler, conference organizer, and Jeffrey Smith, conference commentator, for their comments on the conference version of this paper.

Literature Review

Vaillancourt (1995) reviews the Canadian literature on the rates of return to education. In Table 1, we list the seven studies published since that survey. All these studies use data from the 1991 or 1996 census. The main differences among them are their use of mean earnings or of individual observations to calculate earnings profiles and the type of rate of return estimated. If we limit ourselves to the most comparable sets of numbers — private rates of return for a bachelor's degree by sex (four studies) — we find a remarkable degree of agreement with rates for men in the 14 to 17 percent range and for women in the 15 to 19 percent range.

Note that we limit our list to studies on the rates of return and omit studies on the returns to education. The latter studies examine the effect education has on labor income (wages, earnings, and so on), measured using either a continuous years-of-schooling variable, which is assumed to have a linear or quadratic impact on labor income, or a set of dichotomous variables related to the level of schooling attained. Such studies, although quite useful for labor market analysis, do not link the costs of schooling to its impact on labor income; they are thus not comparable to our study.

Methodology

This section presents our analytical framework and the assumptions used, and then explains the data sources and the calculations themselves.

Analytical Framework

We apply the standard analytical framework to calculate rates of return. We use pre- and post-investment earnings profiles to measure benefits, while up-front costs include forgone earnings and overall out-of-pocket expenses.

Table 1: ***Rates of Return to Education Studies for Canada, 1996–2000***

Study: Data Year and Area	Type of Rate of Return	Income Data, Methodology[a]	Tax Issues	Rates of Return
Stager (1996): 1990, Ontario	Private and total rates for men and women, BA/BSc., all and by field of study	Mean earnings by age group, 1991 census	Yes, using taxation statistics data by income class	Private rates are 13.8% (men) and 17.8% (women); total rates are 10.7% (men) and 11.9% (women) for a bachelor's degree; return varies by field of study
Dickson, Milne, and Murrell (1996): 1990, New Brunswick	Total private and fiscal (provincial and federal), men and women separate, rates for university degrees	1991 census, OLS	Yes, using simulations	Fiscal rates between 4.3% and 5.1% overall; private rates between 7.6% and 11.6%; social rates between 6.1% and 8.5%
Stager (1998): 1995, Ontario	Total and private rates, men and women separate, bachelor's degree, all and by field of study	Mean earnings by age group, 1996 census	Yes, using taxation statistics by income class	Private rates are 13.1% (men) and 19.0% (women); total rates are 9.7% (men) and 10.7% (women) for a bachelor's degree[b]
Vaillancourt (1997): 1990, Canada	Private and total rates, men and women separate, BA/BSc., MA/MSc./PhD and Health, plus field of study for undergraduates	1991 census, OLS	Yes, using simulations	Private rates are 15% (men) and 18% (women); total rates are 9% (men) and 8% (women) for a bachelor's degree. Returns vary by field of study
Demers (2000): 1990 and 1995, Quebec	Private rate, bachelor's degree; 75% of difference in rate of return attributed to schooling	Mean earnings by age group, 1991 and 1996 censuses	Yes, using Fraser Institute data on personal, payroll, corporate, sales, and property taxes	Private rate is 11.1% in 1990 and 9.5% in 1995 for a bachelor's degree
Demers (1999): 1990 and 1995, Quebec	Fiscal rate, bachelor's degree	Mean earnings by age group, 1991 and 1996 censuses	Yes, using Fraser Institute data on personal, payroll, corporate, sales, and property taxes	Fiscal rate is 8.7% in 1990 and 10.5% in 1995
Bourdeau-Primeau (1999): 1995, Canada	Private and total rates, men and women separate, BA/BSc., MA/MSc./PhD and Health plus field of study BA/BSc.	1996 census, OLS	Yes, using simulations	Private rates are 17% (men) and 15% (women); total rates are 10% (men) and 10% (women) for a bachelor's degree

[a] Statistics Canada is the source for the cost data in all these studies except Demers (1999; 2000), who uses data from the Quebec government.

[b] Stager's returns are reported in Table A-11 of this paper.

We then solve the following regression for a rate of return, r, such that the present value of the income stream associated with schooling is given by:

$$0 = \sum_{i=1}^{N} \frac{(A_i - B_i)}{(1 + r)^i} - C,$$

where N denotes the number of years of earnings after the investment, A and B the after and before investment earnings profiles, and C the up-front costs.

Such a calculation may yield a positive, zero, or negative rate of return, depending on the relative size of the differences in earnings and the costs of the investment.

Assumptions

The standard analytical framework contains a set of more or less explicit assumptions. The following list presents them and, for most, indicates their effect on calculated rates of return as a bias that is positive (overestimation) or negative (underestimation).

1. Benefits are measured only by earnings. Fringe benefits from employment are excluded. Because these fringe benefits normally increase as a percentage of wages and salaries when wages and salaries increase, this simplifying assumption gives a negative bias to the model.
2 All monetary costs are included and assumed to be incurred in the year immediately preceding graduation; thus they are not discounted. Nonmonetary benefits, such as civic participation and child-rearing skills, are omitted.
3. No correction is made for differences in the abilities of individuals with and without higher levels of schooling. This assumption likely has a positive bias since the impact of abilities is captured by schooling differences (more able individuals go on to higher levels of schooling).
4. Individuals with no employment income are excluded — to allow the computation of the natural logarithm (ln) of earnings. This has a positive bias, since lack of employment income is not entirely explained by level of university schooling.

5. Earnings are defined as wages plus self-employment income. The consequent inclusion of the returns to the nonhuman capital used by the self-employed has a slight positive bias.
6. The same retirement age is used for everyone, and no correction is made for differential mortality rates by level of schooling. This assumption has a negative bias, but it is small because discounting reduces the impact of earnings received 30 or 40 years after graduation.
7. The income tax is fully indexed, and no excess burden of taxes is taken into account. This assumption has a positive bias for private rates of return, because the income tax has historically been less than fully indexed to inflation, and for public rates of return, because omitting the excess burden underestimates the costs of public support to university education.
8. No productivity growth occurs. This simplifying assumption has a negative bias; allowing productivity to rise would increase earnings.
9. A single year represents the life cycle. This common assumption undoubtedly has some effect on the calculated rates of return, but its direction is uncertain.

The two crucial assumptions, in our opinion, are the omission of nonmonetary benefits, such as better child-rearing skills, and more societal implication through volunteerism or greater participation in the political process, and the lack of correction for differences in abilities between individuals with different levels of schooling.

On the former point, one can do little except to note that it may be quite important (Stager 1996) or that more systematic research should be carried out.[1] Because of the latter point, some authors use information extraneous to their study to correct their rates of return to account for this. Constantatos and West (2000) reduce them on the basis of their reading of the literature; thus, their social rate of return to university education goes from 9.9 percent to 7.6 percent. By presenting uncorrected rates, we leave readers free to carry out whatever modification they deem appropriate.

1 As Jeffrey Smith argues persuasively elsewhere in this volume.

Fields of Study

Because we present rates of return for various levels of university education and various fields of study, we must specify the programs to which each field corresponds.[2] We used the following groupings:

Education:	primary and secondary, general and specialized (physical education and so on), counselling
Humanities:	fine and applied arts, music, drama, classics, languages, philosophy, communications, history, library science
Social sciences:	geography, anthropology, sociology, economics, political science, psychology, social work, law
Commerce:	management, business
Pure sciences:	agriculture, biological, pure and mathematical sciences
Engineering:	engineering and applied sciences
Health sciences:	nursing, health professions (speech therapy, physiotherapy and so on)

Notice that some of the groupings are quite wide; the social sciences, for example, include law.

Data and Calculations

The formula given above requires us to know the lifetime earnings of individuals, with and without the level of schooling, for which a rate of return is being calculated — *A* and *B* — and the costs, *C*. We first explain how we obtain *A* and *B* and then turn to *C*.

After and Before Investment Earnings (*A* and *B*)

We take data on earnings from the public use microdata files of the 1991 and 1996 Canadian censuses. These files comprise, respectively,

2 We constructed this list with microdata file code books. The census variables and codes are presented in Appendix Table A-1.

a 3.0 percent sample from all 1991 census respondents and a 2.8 percent sample from 1996 (drawn from long-form respondents). The number of individuals used in the analysis appears in Appendix Tables A-3 and A-4.

Earnings profiles by degree were obtained by using the following equation:

$$\ln(\text{earnings}) = B_0 + (B_1 \times \text{Age}) + (B_2 \times \text{Age}^2) + \left[\sum_{i=1}^{7} (B_{i3} \times \text{Fields}) + \sum_{i=2}^{7} (B_{i4} \times \text{Fields} \times \text{Age})\right].$$

We use the standard semi-logarithmic relation between earnings and age/age^2 and ordinary least squares (OLS) regressions to estimate returns by level of education. In other words, we relate the natural logarithm of earnings, not earnings *per se*, to the age and field-of-studies variables. The statistical technique of OLS allows us to find the set of coefficients that best represents the relationship between the variable to be explained (earnings) and the factors that explain it (age and fields of studies). When we take fields of study into account, we add the terms in square brackets to modify the intercept and the slope of the equation. Appendix Tables A-3 through A-6 report our regression results for 1990 and 1995.

With these equations, we calculate each individual's earnings for each year in the labor market. To do this, we make assumptions about age at attaining various levels of education and at retirement. Students are assumed to graduate from high school and start university studies at age 18, to end their BA or BSc studies at age 22. If they continue in school, they finish their MA or MSc or health degree studies at age 24 (after receiving a BA or BSc) and their PhD at age 28 (after receiving an MA or MSc). They then enter the work force and work until they retire at age 63.

For example, to calculate the rate of return for a man who received a BComm in 1995, we compute for each age from 22 to 62 — that is, for 41 years — the earnings of a BComm holder and, in contrast, those of a high school graduate. Thus, for a 30-year-old:

$$\text{BComm earnings} = 6.8369 + (0.1661 \times 30) + (-0.0018 \times 900) + (-0.0140) + (0.0047 \times 30) = 10.3269,$$

of which the exponential value (antilog) is $30,543;

$$\text{high school earnings} = 6.1765 + (0.1797 \times 30) + (-0.0019 \times 900)$$
$$= 9.8575,$$

of which the exponential value (antilog) is $19,101.

For total rates of return, we calculate for each of the 41 years the difference between the higher level and the lower level of education to obtain the difference between *A* and *B*. In our example, the difference at age 30 is

$$\$30,543 - \$19,101 = \$11,442.$$

For private rates of return, we must find the individual's after-tax income — gross income minus personal income tax. We calculated it for a single individual who claims the personal exemption, employment insurance (EI) and Canada (or Quebec) Pension Plan (CPP/QPP) credits, and the allowable registered retirement savings plan (RRSP) deduction of 18 percent of earnings to a maximum of $13,500). For both years, we use the federal income tax schedule and the Ontario tax-on-tax rate as a proxy for the provincial rates (see Table 2).

In our example, according to the parameters of the tax table, $30,053 becomes $25,993 and $19,101, $16,896. We then subtract these amounts to obtain the difference between *A* and *B* for private rates of return:

$$\$24,987 - \$16,896 = \$8,091.$$

Up-Front Costs (*C*)

For our basic equation, we need the up-front costs of an individual's investment in education. These costs are tuition, other out-of-pocket expenses (textbooks, and so on), and forgone earnings.

The amounts that we used for tuition and other out-of-pocket expenses are set out in Table 3 (the sources and methods of calculation are listed in Appendix Table A-2). To obtain a total for a particular level of education, we added the two amounts and multiplied the result by the appropriate number of years of study.

Table 2: ***Tax Parameters Used in the Simulation of Private Income***

Parameter	1990	1995
Personal exemption	$6,169	$6,456
First tax bracket: 17% rate	$0–$28,275 taxable income	$0–$29,590 taxable income
Second tax bracket: 26% rate	$28,276–$56,550 taxable income	$29,591–$59,180 taxable income
Third tax bracket: 29% rate	More than $56,550 taxable income	More than $59,180 taxable income
Ontario tax rate	53% of federal tax	58% of federal tax
EI contribution rate	1.95%	3.0%
EI maximum taxable earnings (weekly)	$640	$815
CPP/QPP contribution rate	2.2%	2.7%
CPP/QPP minimum taxable earnings (annual)	$2,800	$3,400
CPP/QPP maximum taxable earnings (annual)	$28,900	$34,900
RRSP contribution rate	18% of earnings	18% of earnings
RRSP maximum contribution	$13,500	$13,500

Source: Authors, drawing on Canadian Tax Foundation 1990; 1995.

For example, we calculated the up-front private costs of a bachelor's degree obtained in 1995 as follows:

> Out-of-pocket expenses $1,753 + Tuition $2,633 = $4,386 per year × 4 = $17,544.

Then we calculated forgone earnings, using the equation associated with the *B* income stream. Because postsecondary students usually attend classes only eight months a year (and spend the other four working), we assumed they forgo two-thirds of the annual earnings of high school graduates of the appropriate age. For example, we calculate the earnings forgone by a man who completed a BComm in 1995 as two-thirds of the sum of the earnings of a male high school graduate over the ages of 18, 19, 20, and 21. Those annual forgone amounts were $20,735 (private) and $20,818 (total).

Table 3: ***Annual Cost Data, 1990 and 1995***

	1990	1995
		(current dollars)
		Private Costs
Tuition		
University		
Undergraduate, all fields	1,687	2,633
Graduate, all levels	1,547	2,688
Other out of pocket		
University, all levels	1,139	1,753
		Public Costs
University		
Undergraduate, all fields	17,797	17,386
Graduate		
Master's level	29,663	28,977
PhD level	71,190	69,545

Note: For both tuition and other out-of-pocket expenses, annual costs are added up for the relevant number of years, without present value calculations: bachelor's degree, four years (after high school); master's degree, two years (after a bachelor's); and a PhD, four years (after a master's).

These earnings were calculated on an annual basis using the relevant equations of Appendix Tables A-3 and A-4. Thus, the earnings of a woman age 18 used in the calculations of the 1990 rates of return were:

$$7.3944 + (0.0966 \times 180 + (-0.0011 \times 324) = 8{,}7768,$$

with the antilog yielding $6,482 for a full year and thus $4,317 for eight months.

The results of our calculations are set out in Tables A-7 through A-10. We then combine *A*, *B*, and *C* using the internal rate of return (IRR) function of the Excel spreadsheet program.

Returns to Education

In this part of the paper, we present our result, by levels of education and, for bachelor's degrees, by fields of study.

Results by Levels of Education

Table 4 sets out our results by level of postsecondary education. Our key findings here are as follows:

- Private rates of return for bachelor's degrees are high in absolute and relative terms, ranging between 16 and 20 percent in 1990 and 1995. Recall that these are *real after-tax rates of return*. To obtain a similar rate of return on a financial asset would require at least a 30 percent before-tax rate of return. In 1990, the nominal yield on a 10-year government of Canada bond was 10.3 percent, and in 1995, it was 7.1 percent.
- The total rates of return for bachelor's degrees are only about half the private rates of return. The reason for the difference is the high level of subsidies to higher education in Canada; tuition fees represent only about a quarter to a third of the cost of an undergraduate degree (the exact proportion varies across provinces). Notice, however, that the rates of return are still high. They show, for example, that the amount spent on producing one extra bachelor's degree earned 10 percent in real terms in 1995 in the labor market. (And recall that we are neglecting nonpecuniary returns.)
- Rates of return for master's and PhD degrees are substantially lower than those for bachelor's degrees. This result is found in studies of returns to education across the world. The main reason is the fact that the high returns associated with a bachelor's degree elevate the opportunity cost of graduate studies. Their relatively low rates of monetary returns may be misleading as a guide for funding purposes if their other benefits, such as growth-generating externalities (Martin and Trudeau 1998), increase with schooling.

Results by Field of Study

Turning to Table 5, we find that rates of return vary across fields of university studies. The lowest returns are from humanities, while

Table 4: *Private and Total Rates of Return by Level of University Education, 1990 and 1995*

	Bachelor's[a]	Master's[b]	PhD[c]
		(percent)	
		1990	
Men			
Private	16	9	7
Total	8	4	1
Women			
Private	19	10	8
Total	8	4	–2
		1995	
Men			
Private	17	< 0*	3
Total	10	< 0*	–2
Women			
Private	20	5	12
Total	10	0	2

Note: Some rates of return could not be calculated because of technical issues, such as the *A* and *B* earnings profiles crossing each other twice, or because of high initial negative values. In such a case, we examined the profiles involved and indicate here by 0* if the rate of return was close to zero and < 0* if it was negative.

[a] Compared with completed secondary schooling.

[b] Compared with a bachelor's degree.

[c] Compared with a master's degree.

Source: Authors' calculations, using data in Tables A-3 through A-10.

the highest are obtained from fields that demand some mastery of science or mathematics, such as engineering or commerce.

This result may, in part, reflect the objective difficulty of mastering mathematics and science as opposed to less-demanding subjects. Or it may come from young peoples' belief that science is more difficult, a belief that leads some capable students to shy away from these fields. One cannot sort out these two influences, although we suspect that both are present.

Table 5: ***Private and Total Rates of Return to a Bachelor's Degree, by Field of Study, 1990 and 1995***

	Education	Humanities	Social Sciences[a]	Commerce	Natural Sciences	Engineering	Health Sciences
				(percent)			
				1990			
Men							
Private	19	1	12	15	14	20	8
Total	6	< 0*	9	10	7	9	< 0*
Women							
Private	19	13	19	27	22	37	26
Total	11	7	11	16	9	11	3
				1995			
Men							
Private	14	–3	15	20	19	24	18
Total	11	< 0*	12	15	8	12	4
Women							
Private	19	13	18	25	22	25	28
Total	13	8	12	17	8	8	5

Notes: Calculations are made in comparison to completed secondary schooling. Only coefficients significantly different from zero ($t > 1.65$) are used.

Some rates of return could not be calculated because of technical issues, such as the *A* and *B* earnings profiles crossing each other twice, or because of high initial negative values. In such a case, we examined the profiles involved and indicate here by 0* if the rate of return was close to zero and < 0* if it was negative.

[a] Includes law degrees.

Source: Calculations by the authors using data in Tables A-3 through A-10.

Here, again, it may be useful to take into account the externalities associated with scientific research in allocating funds between fields of studies.

The Robustness of Results

Before concluding, we find it useful to consider the robustness of our findings. First, our rates of return are very stable over a five-year interval. The single exception is men's returns to education in the health field. This outlier may reflect the relatively small number of men in the field (nursing, speech therapy, and so on), which makes estimates of the earnings functions less stable.

Second, a comparison with the results of Stager (1998) for Ontario for 1995 (see Table A-11) is also reassuring. He finds rates of return of the same order as ours. Finally, Finnie obtains results (reported elsewhere in this volume), that agree with ours as to the relative value of various fields of study even though he was using a different database and methodology.

Conclusion

This paper presents a set of rates of return to schooling in Canada for 1990 and 1995. Our main conclusion is that investing in human capital yields high real rates of return, both privately and for society as a whole, with significant differences between fields of studies. This finding holds for results calculated with data associated with a recession year (1990) and an expansion year (1995). Given the size of these returns, increasing tuition fees significantly (doubling them, for example) would not make investing in a bachelor's degree unprofitable from a private perspective.

Appendix Tables

Table A-1: ***Definitions of Level of Schooling and Field of Study, Earnings Regressions, 1990 and 1995***

Level of Schooling	1991–96 Census Data File Variables and Codes	
	(DGREE)	(HLOSP)
Bachelor's degree	6	11
Master's degree	9	13
PhD	10	14
Field of study	(DGMES)	
Education	1	
Humanities	2 or 3	
Social Sciences	4	
Commerce	1991: 5 or 6; 1996: 5–9	
Pure sciences	1991: 7 or 12; 1996: 10 or 18	
Engineering	1991: 8 or 9; 1996: 11–15	
Health sciences	1991: 10 or 11; 1996: 16 or 17	

Note: See the main text for the programs included in each field of study listed here.

Source: Authors, from microdata file codebooks, 1991 and 1996 censuses.

Table A-2: *Annual Cost Data Used, 1990 and 1995*

	Method of Calculation	1990	1995
		(current dollars)	
	Private Costs		
Tuition			
University, all levels	Fees for university students were calculated as the unweighted means of fees of major universities in each region. Fees for undergraduate commerce, education, engineering, and science studies and for graduate (MSc, PhD) studies were taken directly from the source. Fees for humanities and social sciences were for arts degrees. Canadian fees were an unweighted mean of provincial fees for the appropriate field of study. The source is Statistics Canada, cat. 81-219, table 1, 1990/91 and 1993/94, corrected by the Canadian consumer price index tuition fees subindex. In terms of line items (universities) of that table, Atlantic Canada corresponds to lines 1–3, 5, 11, 13–17, Quebec to lines 19–24, Ontario to lines 25–26 and 28–41, the Prairies to lines 43, 44, 46–48, and 53, and British Columbia to lines 54, 56, and 58 (1990 line numbers).		
Undergraduate			
All fields		1,687	2,633
Education		1,564	2,570
Humanities		1,554	2,500
Social sciences		1,554	2,500
Commerce		1,566	2,510
Pure sciences		1,561	2,544
Engineering		1,696	2,708
Health		2,317	3,099
Graduate, all fields		1,547	2,688
Other out of pocket			
University, all levels	Porter and Jasmin 1987, p. 35, table 14, sum of columns 3 and 6. An unweighted sum of the amounts is used to compute the expenses for Canada as a whole. The data are converted to 1990 and 1995 dollars using the consumer price index.	1,139	1,753

Table A-2 - continued

	Method of Calculation	1990	1995
		(current dollars)	
	Public Costs		
University	We use data on enrollments taken from Statistics Canada, 81-204, 1991 and 1996. 1991 data for bachelor's enrollments are from table 7, master's from table 9, and PhD from table 10. Part-time enrollment is converted to full time by multiplying it by one-third. Bachelor's enrollments in education, humanities, commerce, social sciences, and mathematical and natural sciences are obtained by summing lines 2, 3, 4, 5, and 29 minus 35, enrollments in engineering by summing lines 38 and 55, and enrollments in health by summing lines 48 and 35 from table 7. Master's enrollments in education, humanities, commerce, and social sciences are obtained by summing lines 2, 3, 4, 5, and 15 from table 9, while master's enrollments in mathematical and pure sciences, engineering, and health are obtained by subtracting the previous total from line 1 of that table. Similar calculations are made for 1996. Total costs were from Statistics Canada, cat. 81-229, tables 42 through 58, postsecondary – universities column.		
	Breakdowns by Program and Level		
Undergraduate (bachelor's)	Education, humanities, social sciences, commerce, mathematics (1: reference point); pure sciences (1.5); engineering (2); health (3.33; two-thirds of health degrees).	All: 17,797 Ref. point: 11,865	All: 17,386 Ref. point: 11,591
Graduate			
Master's	Education, humanities, social sciences, commerce (2); mathematics and pure sciences, engineering, health (3).	All: 29,663	All: 28,977
PhD	All disciplines (6).	71,190	69,545

Note: For both forgone earnings and out-of-pocket expenses, annual costs are added for the relevant number of years, without present value calculations: bachelor's degree, four years (after high school); master's degree, two years (after a bachelor's); health degree, six years (after high school), and PhD, four years (after a master's).

To calculate the public cost of a bachelor's or master's degree, one multiplies the reference point value by the appropriate factor (1 to 6). For example, the public cost of a bachelor's degree in engineering in 1995 was \$11,591 × 2 = \$23,182 × 4 years, which yields \$92,728 (see Table A-10).

Table A-3: *Regression Results, by Level of Education, OLS, ln (Employment Income), 1990 (1991 Census)*

	Secondary School	Bachelor's Degree	Master's Degree	PhD
			Men	
Constant	6.7734*	7.2457*	6.5514*	6.4381*
	(154.46)	(105.62)	(40.02)	(19.89)
Age	0.1545*	0.1473*	0.1847*	0.1831*
	(67.69)	(44.98)	(25.32)	(14.09)
Age^2	-0.0017*	-0.0016*	-0.0020*	-0.0018*
	(-60.07)	(-41.74)	(-25.04)	(-14.32)
R^2	0.1588	0.1002	0.0949	0.1137
F	2,907.12	1,130.10	320.62	102.67
N	30,793	20,309	6,118	1,602
			Women	
Constant	7.3944*	8.0324*	7.0066*	5.3196*
	(143.17)	(88.44)	(27.97)	(6.53)
Age	0.0966*	0.0938*	0.1498*	0.2346*
	(36.51)	(20.43)	(13.01)	(6.80)
Age^2	-0.0011*	-0.0011*	-0.0017*	-0.0026*
	(-32.95)	(-19.19)	(-12.91)	(-7.21)
R^2	0.0452	0.0249	0.0473	0.1578
F	787.60	224.37	84.73	28.95
N	33,283	17,575	3,412	311

Note: An asterisk indicates that $|T| > 1.96$; T-statistics are in parentheses.

Source: Authors' calculations, based on individual microdata file, 1991 census.

Table A-4: ***Regression Results by Level of Education, OLS, ln (Employment Income), 1995 (1996 Census)***

	Secondary School	Bachelor's Degree	Master's Degree	PhD
		Men		
Constant	6.1765*	6.7681*	6.2867*	6.3183*
	(120.16)	(86.08)	(34.98)	(17.97)
Age	0.1797*	0.1707*	0.1959*	0.1930*
	(67.95)	(45.51)	(24.66)	(13.59)
Age^2	-0.0019*	-0.0018*	-0.0021*	-0.0020*
	(-60.50)	(-42.94)	(-24.49)	(-14.25)
R^2	0.1670	0.0933	0.0858	0.1059
F	2,866.83	1,107.01	304.16	107.80
N	28,600	21,516	6,481	1,822
		Women		
Constant	6.4428*	7.2277*	6.2542*	5.9519*
	(106.58)	(78.39)	(24.84)	(7.70)
Age	0.1389*	0.1340*	0.1859*	0.2017*
	(46.03)	(28.44)	(16.09)	(6.07)
Age^2	-0.0015*	-0.0015*	-0.0021*	-0.0021*
	(-41.05)	(-25.91)	(-15.88)	(-6.16)
R^2	0.0807	0.0464	0.0572	0.0724
F	1,301.36	508.29	129.41	19.01
N	29,648	20,911	4,271	489

Note: An asterisk indicates that $|T| > 1.96$; T-statistics are in parentheses.

Source: Authors' calculations, based on individual microdata file, 1996 census.

Table A-5: ***Regression Results, Bachelor's Level, by Field of Study, ln (Employment Income), 1990 (1991 Census)***

	Men	Women
Constant	7.1333*	7.8455*
	(73.93)	(72.04)
Age	0.1461*	0.0996*
	(39.80)	(20.37)
Age^2	0.0016*	-0.0011*
	(-43.05)	(-19.29)
Field of study[a]		
Arts, humanities	-0.6655*	-0.0305
	(-6.81)	(-0.34)
Social sciences	-0.4224*	-0.0402
	(-4.74)	(-0.44)
Commerce, management	0.0405	0.3605*
	(0.46)	(3.36)
Pure and biological sciences	0.0050	0.3633*
	(0.05)	(3.32)
Engineering, applied science and technology	0.1283	0.9904*
	(1.49)	(4.05)
Health sciences, techniques	-0.5742*	0.4580*
	(-3.87)	(4.29)
Field of study × age[a]		
Arts, humanities × age	0.0120*	-0.0042*
	(5.09)	(-1.88)
Social sciences × age	0.0149*	0.0013
	(6.86)	(0.52)
Commerce, management × age	0.0028	-0.0064*
	(1.30)	(-2.10)
Pure and biological sciences × age	0.0029	-0.0105*
	(1.24)	(-3.59)
Engineering, applied sciences and technology × age	0.0038	-0.0235*
	(1.84)	(-3.21)
Health sciences, techniques × age	0.0158*	-0.0087*
	(4.56)	(-3.17)
R^2	0.1284	0.0378
F	213.92	49.24
N	20,309	17,575

Note: An asterisk indicates that $|T| > 1.96$; T-statistics are in parentheses.

[a] Results are calculated with respect to the educational field (the omitted dichotomous variable in the regression).

Source: Authors' calculations, based on individual microdata file, 1991 census.

Table A-6: *Regression Results, Bachelor's Level, by Field of Study, ln (Employment Income), 1995 (1996 Census)*

	Men	Women
Constant	6.8369*	7.1369*
	(62.45)	(67.10)
Age	0.1661*	0.1354*
	(40.20)	(27.43)
Age^2	0.0018*	-0.0015*
	(-42.57)	(-25.32)
Field of study[a]		
Arts, humanities	-0.5084*	-0.0877
	(-4.72)	(-1.01)
Social sciences	-0.3292*	-0.0623
	(-3.36)	(-0.75)
Commerce, management	0.0140	0.3066*
	(-0.14)	(3.18)
Pure and biological sciences	0.2364*	0.2928*
	(2.27)	(2.78)
Engineering, applied science and technology	0.2547*	0.7955*
	(2.64)	(3.99)
Health sciences, techniques	-0.0078*	0.4273*
	(-0.04)	(4.12)
Field of study × age[a]		
Arts, humanities × age	0.0059*	-0.0030
	(2.31)	(-1.41)
Social sciences × age	0.0110*	0.0013
	(4.75)	(0.59)
Commerce, management × age	0.0047*	-0.0051
	(2.02)	(-1.94)
Pure and biological sciences × age	-0.0044	-0.0073*
	(-1.75)	(-2.69)
Engineering, applied sciences and technology × age	-0.0007	-0.0231*
	(-0.31)	(-4.02)
Health sciences, techniques × age	0.0036	-0.0058
	(0.86)	(-2.26)
R^2	0.1172	0.0599
F	203.81	95.07
N	21,516	20,911

Note: An asterisk indicates that $|T| > 1.96$; T-statistics are in parentheses.

[a] Results are calculated with respect to the educational field (the omitted dichotomous variable in the regression).

Source: Authors' calculations, based on individual microdata file, 1996 census.

Table A-7: *Private and Public Costs for Various Levels of Education, 1990*

	Direct Costs[a]	Forgone Earnings[b]		Total[c]	
		Men	Women	Men	Women
		(current dollars)			
		Private Costs			
Bachelor's degree	11,304	24,150	18,790	35,454	30,094
Master's degree	5,372	20,385	17,621	25,757	22,993
PhD	10,744	49,399	39,733	60,143	50,477
		Public Costs			
Bachelor's degree	71,188	24,916	18,790	96,104	89,978
Master's degree	59,326	22,878	19,413	82,204	78,739
PhD	284,760	56,576	44,456	341,336	329,216

[a] Total private or public costs found in Table 3 × the number of years of education necessary.

[b] Two-thirds (portion of the year spent studying) × the annual earnings that would have been gained if the person had worked instead.

[c] Direct costs + forgone earnings.

Source: Authors' calculations.

Table A-8: *Private and Public Costs for Various Levels of Education, 1995*

	Direct Costs[a]	Forgone Earnings[b]		Total[c]	
		Men	Women	Men	Women
		(current dollars)			
		Private Costs			
Bachelor's degree	17,544	20,735	14,242	38,279	31,786
Master's degree	8,882	19,578	16,243	28,460	25,125
PhD	17,764	47,687	36,893	65,451	54,657
		Public Costs			
Bachelor's degree	69,544	20,818	14,242	90,362	83,786
Master's degree	57,954	21,717	17,522	79,671	75,476
PhD	278,180	54,163	40,587	332,343	318,767

[a] Total private or public costs found in Table 3 × the number of years of education necessary.

[b] Two-thirds (portion of the year spent studying) × the annual earnings that would have been gained if the person had worked instead.

[c] Direct costs + forgone earnings.

Source: Authors' calculations.

Table A-9: *Private and Public Costs, Bachelor's Degree, by Field of Study, Compared with Completed Secondary Education, 1990*

	Direct Costs[a]	Forgone Earnings[b]		Total[c]	
		Men	Women	Men	Women
		(current dollars)			
		Private Costs			
Education	10,811	24,150	18,790	34,961	29,601
Humanities	10,772	24,150	18,790	34,922	29,562
Social sciences	10,772	24,150	18,790	34,922	29,562
Commerce	10,819	24,150	18,790	34,969	29,609
Pure sciences	10,801	24,150	18,790	34,951	29,591
Engineering	11,340	24,150	18,790	35,490	30,130
Health sciences	13,826	24,150	18,790	37,976	32,616
		Public Costs			
Education	47,460	24,216	18,790	71,676	66,250
Humanities	47,460	24,216	18,790	71,676	66,250
Social sciences	47,460	24,216	18,790	71,676	66,250
Commerce	47,460	24,216	18,790	71,676	66,250
Pure sciences	47,460	24,216	18,790	95,406	89,980
Engineering	94,920	24,216	18,790	119,136	113,710
Health sciences	237,300	24,216	18,790	261,516	256,090

[a] Total private or public costs found in Table 3 × the number of years of education necessary.

[b] Two-thirds (portion of the year spent studying) × the annual earnings that would have been gained if the person had worked instead.

[c] Direct costs + forgone earnings.

Source: Authors' calculations.

Table A-10: ***Private and Public Costs, Bachelor's Degree, by Field of Study, Compared with Completed Secondary Education, Canada, 1995***

	Direct Costs[a]	Forgone Earnings[b]		Total[c]	
		Men	Women	Men	Women
		(current dollars)			
		Private Costs			
Education	17,295	20,735	14,242	38,030	31,537
Humanities	17,011	20,735	14,242	37,746	31,253
Social sciences	17,011	20,735	14,242	37,746	31,253
Commerce	17,054	20,735	14,242	37,789	31,296
Pure sciences	17,187	20,735	14,242	37,922	31,429
Engineering	17,844	20,735	14,242	38,579	32,086
Health sciences	19,410	20,735	14,242	40,145	33,652
		Public Costs			
Education	46,364	20,818	14,242	67,182	60,606
Humanities	46,364	20,818	14,242	67,182	60,606
Social sciences	46,364	20,818	14,242	67,182	60,606
Commerce	46,364	20,818	14,242	67,182	60,606
Pure sciences	69,546	20,818	14,242	90,364	83,788
Engineering	92,728	20,818	14,242	113,546	106,970
Health sciences	231,820	20,818	14,242	252,638	246,062

[a] Total private or public costs found in Table 3 × the number of years of education necessary.

[b] Two-thirds (portion of the year spent studying) × the annual earnings that would have been gained if the person had worked instead.

[c] Direct costs + forgone earnings.

Source: Authors' calculations.

Table A-11: ***Private and Total Rates of Return, Bachelor's and First Professional Degree Programs, Ontario, 1995***

	Men		Women	
	Total	Private	Total	Women
		(percent)		
Humanities, fine arts	4.4	5.6	9.8	15.1
Social sciences[a]	9.4	11.4	11.3	17.5
Biological sciences[b]	5.0	7.1	8.5	16.1
Mathematics, physical sciences	11.3	15.6	13.2	22.2
Health professions[c]	9.8	14.5	12.4	23.9
Commerce	13.6	16.9	14.5	23.2
Engineering[d]	10.5	15.1	11.0	21.7
Law	13.0	14.6	13.6	17.7
Medicine[e]	13.9	20.2	11.6	20.6
All bachelor's degrees[f]	9.7	13.1	10.7	9.0

[a] Excludes commerce, social work, law.

[b] Includes agriculture.

[c] Includes nursing, pharmacy, rehabilitation medicine.

[d] Includes architecture.

[e] Includes dentistry, veterinary medicine, optometry.

[f] Includes LLB, BEd, BSW, and so on.

Source: Stager 1998, tables 1 and 2.

References

Bourdeau-Primeau, Sandrine. 1999. "Les taux de rendement privés et sociaux de l'éducation au Canada." Montreal: Université de Montréal.

Canadian Tax Foundation. 1990. *The National Finances*. Toronto: CTF.

———. 1995. *The Finances of the Nation*. Toronto: CTF.

Constantatos, Christos, and Edwin G. West. 1991. "Measuring Returns from Education — Some Neglected Factors." *Canadian Public Policy* 17 (2): 127–138.

Demers, Marius. 1999. "La rentabilité du diplôme." *Bulletin Statistique de l'éducation* 8. Québec: Ministère de l'Éducation.

———. 2000. "L'éducation..., oui c'est payant!" *Bulletin Statistique de l'éducation* 16. Québec: Ministère de l'Éducation.

Dickson, Vaughan, William Milne, and David Murrell. 1996. "Who Should Pay for University Education: Some Net Benefit Results by Funding Source for New Brunswick." *Canadian Public Policy* 22 (4): 315–329.

Martin, Fernand, and Marc Trudeau. 1998. "L'impact économique de la recherche universitaire." *Dossier de recherche* 2 (3). Ottawa: Association of Colleges and Universities of Canada.

Porter, Marion, and Gilles Jasmin. 1987. *Profile des étudiants du niveau postsecondaire au Canada*. Ottawa: Secrétariat d'État and Statistics Canada.

Statistics Canada. 81-204. *Universities, Enrolment and Degrees*, 1991 and 1996. Ottawa: Statistics Canada.

———. 81-219. *Tuition Fees and Living Accommodation Costs at Canadian Universities*. 1990/91 and 1993/94. Ottawa: Statistics Canada.

———. 81-229. *Education in Canada: A Statistical Review*, 1990/91 and 1995/96. Ottawa: Statistics Canada.

Stager, David. 1996. "Returns to Investment in Ontario University Education, 1960–1990, and Implications for Tuition Fee Policy." *Canadian Journal of Higher Education* 26 (2): 1–22.

———. 1998. "Returns to Investment in University Education in Ontario, 1995." University of Toronto. Mimeographed.

Vaillancourt, François. 1995. "The Private and Total Returns to Education in Canada, 1986." *Canadian Journal of Economics* 28 (3): 532–554.

———. 1997. "The Private and Total Returns to Education in Canada, 1990: A Note." Montreal: Université de Montréal. Mimeographed.

Returns to University Education in Canada Using New Estimates of Program Costs

Kelly Ann Rathje and
J.C. Herbert Emery

This study of the private and total rates of return to university education in Canada differs from others in the area in four ways. First, we use a novel method of calculating the operating costs of providing education by field of study, based on data from the actual budgets of a sample of Canadian universities (see Rathje 2000). The cost figures routinely used in studies of this type arbitrarily account for assumed differences in the intensity of resource use across programs; this method, however, yields direct estimates of the costs in question, and thus more accurately represents the social costs of education in the fields under consideration.

Second, we address the arguments that social investment in programs with low rates of return may still be warranted on the grounds that the returns to university education accrue not just to its recipients, but also to society at large. Specifically, we provide estimates of how large these external benefits of university education would have to be to justify current total expenditures on education in fields where the returns, when measured solely by the incomes of graduates, currently fail to meet a reasonable benchmark.

Third, in calculating private rates of return to university education, we use tuition fee data for 1998; most other existing studies

We thank David Laidler for comments.

are based on less recent figures. This use of more current data has a significant effect on our findings, since, by 1998, fees were on average significantly higher in Canada than they had been earlier in the decade.

Fourth and finally, we discuss the possibility of instituting differential fee levels for different disciplines, offering estimates of the amounts by which fees could be raised (or, in one case, lowered) in order to bring private rates of return down (or up) to the same reasonable benchmark used in analyzing externalities.

In this study, we use what has become standard methodology for measuring the total rates of return to education. We refer the reader to the work by Vaillancourt and Bourdeau-Primeau (in this volume) for a full discussion of the formula, assumptions, and other details of the relevant internal rate of return (IRR) calculations. As our work adopts the same approach as theirs in many essentials, the discussion below highlights only the key ways that our calculations of the returns to education differ from those of Vaillancourt and Bourdeau-Primeau.

Benefits of Total Education

As in other studies that examine the rates of return to higher education, we assume here that earnings reflect a worker's productivity, and measure the benefits of obtaining a given level of education both to society and to the individual, using the incremental increase before-tax and after-tax in earnings, respectively. Nonpecuniary benefits, such as the effects of advanced education in encouraging political involvement, informed decisionmaking, and the bettering of communities, are not included.

To estimate the benefits of university education, we use the following model:

$$\ln(\text{income}) = \beta_0 + \beta_1 \text{age} + \beta_2 \text{age}^2 + \beta_3 \text{bach} + \beta_4 \text{mast} + \beta_5 \text{phd} + \beta_6 \text{medical} + [\textstyle\sum_{i=1}\beta_{7i} \text{degree*field of study}] + \beta_8 D91 + \beta_9 D96 + \epsilon.$$

Using dummy variables, this model accounts for differences in income by level of study (bachelor's, master's, PhD, or medical degree), field of study (education, humanities, agriculture, com-

merce, fine arts, engineering, nursing, health, science, and social sciences), and year in which the income was received (1986, 1991, or 1996).[1] In contrast to Vaillancourt and Bourdeau-Primeau, we do not allow the slope of the age-income profile to vary by field of study, and we assume retirement at age 65. (This difference is one reason our rate-of-return estimates are somewhat lower than theirs.) Using coefficients estimated by the ordinary least squares method for the above log-earnings equation (see Appendix A), we constructed a lifetime earnings stream from age 18 to the assumed retirement age of 65 for each degree-program combination.

We pooled three cross sections of microdata from the censuses (3 percent sample) for 1986, 1991, and 1996 (Statistics Canada 1986; 1991; 1996). All earnings data are deflated into constant (1992) dollars. The data set is restricted to individuals ages 18 to 65 who had completed a university degree, who were paid employees, and who had worked for at least 26 weeks in the census year.[2] We excluded self-employed individuals due to the complexities of interpreting the reported their labor income.[3] Our earnings/income variable is thus based on employment income only, unlike that of Vaillancourt and Bourdeau-Primeau, who use the sum of employment income and self-employment income.[4]

---

1 For a list of variables, see the full regression results in Appendix A.

2 We excluded employed individuals who reported no income despite working more than half the year.

3 With self-employed individuals, reported income may not actually represent earned income due to "income hiding" — whereby some personal expenses are claimed as business expenses in order to reduce reported income for tax purposes. Self-employed individuals may also be able to "split" their incomes with a spouse or other family member who is a co-owner of the business. Finally, self-employment income may also accrue to nonhuman capital.

4 This difference is another factor — probably the main one — causing our rate-of-return estimates to be generally lower than theirs. They acknowledge that the inclusion of self-employment income may introduce an upward bias in the measured rates of return to education, since some portion of self-employment income may be accruing to nonhuman capital. We, in turn, believe that our procedure may result in some downward bias. Our study and theirs together, therefore, define a plausible range within which these rates of return probably actually fall.

Costs

Our calculations include costs for both the individual and society: forgone earnings during the period of educational investment, university operating costs for teaching, and books and supplies; for the student's individual cost, tuition fees are also included. All costs are expressed in constant (1992) dollars.

Forgone Earnings

Forgone earnings are a cost of educational attainment because they represent the opportunity cost of obtaining higher education. Following Dodge and Stager (1972); Vaillancourt (1986; 1995); and Allen (1998), we assume the earnings forgone to obtain a bachelor's degree to be 67 percent of a high school graduate's estimated earnings at age 18 for those ages 18 to 21. The figure of 67 percent follows from the assumption that students work from May through August, and so receive income for one-third of the year. The earnings forgone to obtain a master's degree are assumed to be 50 percent of the bachelor's degree earnings at age 22 for those ages 22 and 23, and the forgone earnings to obtain a PhD are assumed to be 50 percent of the master's degree earnings at age 24 for those ages 24 to 27. We decreased the percentage of forgone earnings included for the graduate degrees to account for fact that graduate students provide a labor supply to universities as teaching and research assistants, so their income is not restricted to the summer months.

Operating Expenses

The cost calculations for the breakdown of university degrees by field of study are calculated using fact books from seven Canadian universities.[5] Rathje (2000) breaks the costs down into two components: a common cost for all faculties in the university and a faculty-

5 The seven universities are Victoria, Saskatchewan, Manitoba, Western Ontario, Memorial University of Newfoundland, Calgary, and Alberta. See Rathje (2000) for the detailed university cost calculations.

specific cost. The program-specific cost is the sum of these two components; the program cost used in the IRR calculations is the mean value for a given field of study's costs across the seven institutions. Details of the construction of these costs appear in Appendix B.

Books and Supplies

These costs come from the University of Calgary calendar for the 1992-93 academic year, and are broken down by program. No supply costs were reported for agriculture or health; we assumed that they were equivalent to those for science and nursing, respectively. The same costs were used for both society and the individual.

Total Rates of Return to University Education

Our calculated total rates of return by level and field of university program are presented in Table 1.

Our results show, as do those of other studies, that the total rates of return to university education are higher for females than for males, and that they decline by the level of study. The highest rates of return are in the technical/scientific and professional programs at the bachelor's level.

We found rates of return to be notably lower than those calculated by Allen (1999) and Vaillancourt and Bourdeau-Primeau (in this volume). The difference is not a result of differences in program costs; in fact, the costs we use are lower than those used by Vaillancourt and Bourdeau-Primeau. Rather, their higher calculated total rates of return result from their inclusion of self-employment income in the earnings measure used to construct the age-earnings profile, their prediction of both higher peak earnings for all programs and a larger annual rate of increase in the age-earnings profile.

We found that, at the bachelor's degree level, relative to a benchmark rate of return of 4.25 percent, investment in the education of males within humanities, fine arts, and nursing cannot be

Table 1: ***Total Rates of Return to University Education***

	Bachelor's Degree		Master's Degree		PhD	
	Males	Females	Males	Females	Males	Females
			(percent)			
Education	4.24	9.48	7.19	10.45	–0.12	–8.23
Humanities	2.35	7.39	—	2.92	2.45	0.76
Agriculture	4.34	6.37	—	–0.69	2.94	0.13
Commerce	8.53	9.23	10.53	12.07	–2.84	—
Fine arts	–2.51	4.65	3.18	–2.65	1.86	2.97
Engineering	10.68	10.80	–6.50	—	–0.36	–0.43
Nursing	1.02	10.91	4.25	2.48	7.31	–12.47
Health	7.09	10.78	8.22	1.88	–4.73	–4.32
Science	8.61	10.42	—	0.90	–2.04	–2.46
Social sciences	7.08	7.98	2.49	6.12	0.42	–1.68
Medicine	0.33					–3.41

Note: (—) indicates that the resulting rate of return was so negative as to be undefined.
Source: Authors' calculations.

justified on the basis of pecuniary benefits alone.[6] In contrast, for females, all fields surpass a 4.25 percent annual real rate of return. At the master's and PhD levels, rates of return for society are lower, and in many cases negative. Graduate education cannot therefore be justified on the basis of monetary returns alone for either sex. This result reflects the fact that both the opportunity costs and the resource costs are high for a graduate education. Interestingly, for males, three of the four highest returns at the PhD level come from liberal arts programs: education, humanities, and social sciences.

6 The choice of benchmark rate for evaluating the investment in university education is somewhat arbitrary. Vaillancourt and Henriques (1986) use 10 percent since it is often the choice of government agencies. Constantos and West (1991) use 6.5 percent since they feel it reflects the real rate of return to physical capital. Allen (1998) uses a 5 percent benchmark. Following Rathje (2000), we use 4.25 percent that reflects the historical range for the real rate of return to capital in Canada between 1964 and 1998.

At this level, science and technical programs have lower rates of return (with the exception of engineering). This is because the forgone earnings costs for these technical programs are higher than those of the liberal arts programs at the same level.

Medical degrees, which one would expect to have high rates of return given the incomes of the medical profession, actually yield low rates of return for both males and females. This surprising result may be, in part, because our study omits self-employed individuals. Many medical professionals, such as dentists, physicians, and veterinarians, own their own practices, and these self-employed individuals may, on average, earn more than their colleagues who are employees. Another factor contributing to the low rates of return in this area is the high operating cost of the programs; Rathje (2000) estimates the cost of a medical education at over $453,000 for four years of study. Finally, given the ability of Canada's public single-payer health insurance systems to control the incomes of physicians and other health care professionals, income-based IRRs probably understate the true total rate of return to a medical education.

Externalities

Some of the programs considered do not, based on monetary benefits alone, warrant the level of investment that society is currently providing. This is particularly true of master's and PhD programs. It is often argued, however, that the rate of return to a university education is underestimated because the calculation omits intangible benefits, or spillover effects.

To address this question sensibly, we need to distinguish between two types of nonpecuniary benefits. There are nonpecuniary benefits of working in some fields that accrue to the workers themselves, such as flexible working conditions or dental plans. These benefits represent an omitted component of the benefits of education that would increase the calculated total rates of return to education were they accounted for, but they are not actual external benefits (that is, benefits accruing to a third party) of advanced education that can be used to justify subsidizing it.

The nonpecuniary benefits we are interested in quantifying are those that are generated by educational investment in an individ-

ual, but that accrue to some individual other than the university graduate or indeed to society at large.[7] To that end, and assuming that private, nonpecuniary benefits omitted from the rate-of-return calculations are negligible, we can quantify an upper boundary for the value of the external benefits of a university education as the extra income needed each year to yield a 4.25 percent rate of return. The formula we use is

$$0 = \frac{(B_t + E_t) - C_t}{(1 + r)^t},$$

where r is 4.25 percent. B_t and C_t still represent the benefits (income) and costs for each year (t). E_t represents the additional earnings that would be needed in each year (t) to ensure that $r = 4.25$ percent.

We estimated the amount of external benefits (as a percentage of income) for the degree-program combinations from Table 1 that did not meet a 4.25 percent rate of return. We summarize the percentage of extra income that would be needed each year to ensure a 4.25 percent rate of return in Table 2.

As the table shows, the percentage of income each year that would be needed to obtain a 4.25 percent rate of return varies greatly depending on the degree and program. In most cases, they seem to us reasonable enough, remembering that these amounts, particularly at the graduate level of study, are anything but negligible. Additional external benefits to society may also be accruing in the form of spillover effects such as increased political involvement. However, the taxpaying public may need to be convinced that investing in these programs is worthwhile.

---

7 If students could choose to pursue studies in whatever program they desired, we would expect that, in equilibrium, the total private rates of return to students would be equalized across all fields. In other words, a lower monetary rate of return for social sciences graduates than for commerce graduates would be compensated for with higher levels of nonwage benefits, such as greater job satisfaction for the social sciences graduate. This theoretical situation does not describe access to all university programs, however. The disciplines with high private monetary rates of return, such as commerce, law, medicine, and engineering, limit their enrollments. The likely outcome in a world where demand for space in these programs exceeds supply is an artificially high rate of return.

Table 2: ***Percentage of Annual Income Attributable to External Benefits***

	Bachelor's Degree		Master's Degree		PhD	
	Males	Females	Males	Females	Males	Females
			(percent)			
Education	0.03	—	—	—	12.05	24.56
Humanities	5.54	—	14.64	2.56	7.29	14.04
Agriculture	—	—	14.99	9.05	4.87	16.42
Commerce	—	—	—	—	16.82	32.93
Fine arts	16.01	—	2.25	12.52	10.03	6.17
Engineering	—	—	9.23	17.13	12.88	15.96
Nursing	9.00	—	—	3.25	—	30.75
Health	—	—	—	4.31	20.30	23.92
Science	—	—	11.36	5.72	19.32	22.93
Social sciences	—	—	2.91	—	11.79	9.25
Medicine	25.83					53.04

Note: (—) indicates that the program met the assumed "risk-free" investment benchmark of 4.25 percent.

Source: Authors' calculations.

Private Rates of Return

To calculate private rates of return, we followed the same method used to calculate rates of return for individuals. After-tax income was used to estimate the private monetary benefits of university education, since it is after-tax income that really represents the increased disposable income enjoyed by the individual.[8] (From a

8 Rathje (2000) uses tax rates from 1992, a basic personal credit of $6,456, and a maximum unemployment insurance and Canada Pension Plan contribution of $1,803. There is also a federal surtax of 4.5 percent of the basic federal tax, plus another 5 percent over $12,500. Each province has an individual provincial surtax; this situation poses a problem for trying to estimate taxes for Canada as a whole. Therefore, a population-weighted average of the provincial surtaxes for 1997 was calculated and used for estimating tax payable. The...

social perspective, taxation has the effect of reallocating the benefits of education between the individual with the human capital and the rest of society.)

We also use tuition fees[9] (rather than total operating costs) in the private rate of return calculations. Since the fees that students pay represent only a fraction of total university operating costs, the cost to the individual is lower than for society. We use tuition fees for 1998 which are much higher levels than those of the early 1990s used in many other studies. Our results for the private rates of return are summarized in Table 3.

Vaillancourt and Bourdeau-Primeau's estimates of the private rates of return are generally higher than ours. Presumably, this is due to the higher private costs in our calculations (our estimations of tuition fees and forgone earnings are higher) and the lower levels and rates of increase in after-tax incomes underlying our results. Indeed, quite unlike those of Vaillancourt and Bourdeau-Primeau, our results indicate that, at the bachelor's level, the private rates of return to undergraduate education are lower than the social rates of return. At the master's and PhD levels, the opposite is true: the returns to the individual are higher than to society. This is because, although the total resource costs of education increase dramatically from the bachelor's to the graduate level, the tuition fees paid by graduate students do not reflect this increase. Thus, the gain in income to graduate study is not particularly large relative to the resource cost of the program, but it is large relative to the student's tuition costs.

Note 8 - cont'd.

...number of observations in the data set from each province, as a percentage of the total number of observations, was used to calculate a weighted average tax rate: 54.32 percent. Rathje ignores deductions for items such as charitable donations, child care, and registered retirement savings plans, so the level of after-tax income may be underestimated.

9 The annual tuition costs are for the 1998-99 academic year. The information on tuition and fees came from the websites of the universities used: www.uvic.ca; www.ucalgary.ca; www.ualberta.ca; www.usask.ca; www.umanitoba.ca; www.uwo.ca; and www.mun.ca. In calculating the IRR, the fees were converted to constant 1992 dollars.

Table 3: *Private Rates of Return to University Education*

	Bachelor's Degree		Master's Degree		PhD	
	Males	Females	Males	Females	Males	Females
			(percent)			
Education	3.40	8.95	9.24	12.99	0.75	–7.51
Humanities	1.75	7.31	—	5.22	6.13	3.68
Agriculture	3.90	6.58	—	1.52	5.59	2.37
Commerce	7.40	8.60	11.88	14.83	–2.46	—
Fine arts	–2.91	4.94	6.55	–0.30	5.53	7.80
Engineering	9.62	10.35	–6.19	—	0.32	1.38
Nursing	0.46	10.28	7.05	4.26	10.35	–11.91
Health	6.39	10.51	11.00	3.67	–4.11	–2.95
Science	7.89	10.25	—	2.43	–0.29	–0.65
Social sciences	6.18	7.63	4.07	9.36	1.74	0.51
Medicine	5.39					1.26

Note: (—) indicates that the resulting rate of return was undefined.
Source: Authors' calculations.

As shown in Table 3, females experience higher rates of return than males from all programs at the bachelor's level, and from most programs at the master's level. At the PhD level, males experience a higher rate of return than females. These differences in rates of return may help to explain some features of university enrollment and participation. In particular, the high private rates of return at the undergraduate level of study for females combined with the lower — in some programs, marginal — rates of return for males may explain why university enrollment has grown faster among women than men, to the point that there are now more female university students than male university students in Canada. Similarly, the fact that many PhD programs are dominated by male students may be a result of the fact that a PhD is an unprofitable investment for females.

Implications for Tuition Policy

In the current climate of funding cutbacks to education, a "user-pay" argument has emerged. Universities want to increase tuition fees to try to recover revenue lost through cutbacks to government funding. Davenport addresses such a user-pay approach in recommending ways for Ontario universities to restructure, while still maintaining the goals of quality education, accessibility, and affordability to all. He comments that "the universities have the option of requiring students in faculties with relatively high costs and/or relatively high earnings expectations to pay a larger share of the costs of their programs" (1996, 30). Implementing this type of system would allow high-cost, high-income programs to pay more of their share of the cost of the education.

Table 4 shows the level at which tuition fees for bachelor's degree programs could be set each year (based on a four-year program) while still allowing a 4.25 percent private rate of return.

As the table shows, only fine arts programs would require a subsidy. All the other programs could endure an increase in tuition and still be worthwhile investments — that is, they could offer students, on average, at least a 4.25 percent private rate of return.

These results suggest that Davenport's proposal for differential tuition fees is workable. Tuition fees could be linked to both the cost of the program and expected earnings after graduation. Under differential tuition fees, programs such as engineering, where the cost per student is high and graduates earn high average incomes, would have higher fees than a program such as humanities, in which both the costs and expected average incomes are lower. As Davenport states, the result is that students with higher costs and higher expected average earnings would be paying an average share of the program costs. Lowering fees for programs with lower teaching costs and lower average potential future income would lead to a more uniform return over degree programs.

Conclusions

The results of this study are somewhat different from previous findings: we found generally lower returns to university educa-

Table 4: ***Tuition Levels Needed to Render a 4.25 Percent Private Rate of Return (Bachelor's Programs)***

	Average of Male and Female Private Rate of Return	Tuition Currently Charged	Tuition Needed to Result in a 4.25% Private Rate of Return	Percentage Change
	(%)	(1992 $)	($)	(%)
Education	6.18	3,332	11,073	232.31
Humanities	4.53	3,201	5,085	58.86
Agriculture	5.24	3,138	6,625	111.12
Commerce	8.00	3,873	19,050	391.87
Fine arts	1.02	3,282	-3,320	-201.16
Engineering	9.99	3,382	27,900	724.96
Nursing	5.36	3,278	10,340	215.44
Health	8.45	3,293	20,200	513.42
Science	9.07	3,221	22,700	604.75
Social sciences	6.91	3,207	13,100	308.48

Source: Authors' calculations.

tion. We also offer a clearer breakdown of how expenses per student vary from undergraduate to graduate degrees. In most cases, our results suggest that undergraduate education is a worthwhile investment for both society and the individual acquiring the education. They also imply that, if tuition fees continue to rise, they should rise differentially according to program rates of return rather than uniformly across all programs as they have in the past.

Within Canada, proposals for educational reform continue to rely primarily on the tax system for funding (see, for example, Donnelly, Welch, and Young 1999). Thus, it is interesting to note how government policy toward advanced education in Canada reflects the levels of social rates of return that we calculate. Governments have responded to taxpayer demands for the maintenance (if not expansion) of access to undergraduate university education. Our estimates suggest that resources for undergraduate teaching are the easiest to justify, since undergraduate education

generates the largest and most concrete social returns of all of the levels of university education. Universities have had to work much harder to convince governments that resources for research and graduate student training is worthwhile. Our estimates suggest that the reason for this may be that, although the benefits to society from such spending may exist, they are not as obvious to the public as monetary returns are. Where the federal government has increased resources for graduate students for research and development activities through the creation of the Canada Foundation for Innovation, it has targeted these resources in the areas of health, the environment, and science and engineering — fields of study where the monetary returns are clear.

Appendix A: Regression Results for Canadian University Graduates

Table A-1: *Regression Results for Canadian Male University Graduates*

Variable	Coefficient	T-statistic	Standard Error
constant	7.7571*	348.195	0.0223
age	0.1218*	104.208	0.0012
age2	-0.0012*	-84.994	0.0000
bach	0.2759*	35.163	0.0078
mast	0.3567*	25.179	0.0142
phd	0.4846*	20.167	0.0240
medical	0.6092*	32.606	0.0187
ba*educ	-0.0991*	-8.510	0.0117
ba*humm	-0.1493*	-11.399	0.0131
ba*agri	-0.0857*	-4.909	0.0175
ba*mngt	0.0614*	5.958	0.0103
ba*art	-0.2352*	-7.347	0.0320
ba*engg	0.1568*	14.421	0.0102
ba*nurse	-0.1795*	-2.813	0.0638
ba*health	0.0102	0.378	0.0270
ba*science	0.0710*	5.974	0.0119
D91	-0.0528*	-11.731	0.0045
D96	-0.1305*	-28.467	0.0046
ma*educ	-0.0220	-1.169	0.0188
ma*humm	-0.2557*	-11.899	0.0215
ma*agri	-0.1899*	-5.993	0.0317
ma*mgnt	0.2050*	11.102	0.0185
ma*art	-0.2010*	-3.599	0.0558
ma*egg	0.0831*	4.257	0.0195
ma*nurse	-0.1397	-0.622	0.2245
ma*health	0.1246*	3.075	0.0405
ma*science	-0.0152	-0.642	0.0236
phd*educ	-0.0449	-0.954	0.0471
phd*humm	-0.1501*	-3.940	0.0381
phd*agri	-0.0969*	-2.528	0.0383
phd*mngt	0.1331*	2.176	0.0612
phd*art	-0.1065	-0.911	0.1169
phd*engg	0.0575	1.574	0.0366
phd*nurse	0.1284	0.404	0.3178
phd*health	0.0335	0.713	0.0470
phd*science	-0.0583**	-1.850	0.0315

Note: F-statistic = 1307.76; R^2 = 0.3074; n = 108,525.

* Statistically significant at the 5 percent level.

** Statistically significant at the 10 percent level.

Table A-2: ***Regression Results for Canadian Female University Graduates***

Variable	Coefficient	T-statistic	Standard Error
constant	8.0273*	285.222	0.0281
age	0.0940*	61.635	0.0015
age2	–0.0010*	–51.667	0.0000
bach	0.3876*	40.959	0.0095
mast	0.5676*	28.089	0.0202
phd	0.7637*	15.370	0.0497
medical	0.6617*	19.537	0.0339
ba*educ	0.0675*	5.671	0.0119
ba*humm	–0.0168	–1.144	0.0147
ba*agri	–0.0523*	–2.547	0.0205
ba*mngt	0.0620*	4.365	0.0142
ba*art	–0.1173*	–4.211	0.0278
ba*engg	0.1413*	4.870	0.0290
ba*nurse	0.1339*	7.111	0.1339
ba*health	0.1455*	6.515	0.0223
ba*science	0.1270*	6.638	0.0191
D91	–0.0320*	–5.390	0.0059
D96	–0.0707*	–11.730	0.0060
ma*educ	0.1401*	5.338	0.0262
ma*humm	–0.0879*	–2.959	0.0297
ma*agri	–0.1734*	–3.579	0.0485
ma*mngt	0.1836*	5.598	0.0328
ma*art	–0.2568*	–3.652	0.0703
ma*engg	–0.0787	–1.446	0.0544
ma*nurse	0.0509	0.937	0.0544
ma*health	0.0539	1.236	0.0436
ma*science	0.0182	0.389	0.0469
phd*educ	–0.0401	–0.417	0.0963
phd*humm	–0.0909	–1.168	0.0778
phd*agri	–0.2138*	–2.531	0.0845
phd*mgnt	–0.0542	–0.260	0.2082
phd*art	–0.1254	–0.637	0.1970
phd*engg	–0.1406	–0.954	0.1473
phd*nurse	–0.1413	–0.423	0.3339
phd*health	–0.0882	–1.008	0.0875
phd*science	–0.0829	–0.812	0.1022

Note: F–statistic = 613.18; R^2 = 0.2275; n = 76.888.

* Statistically significant at the 5 percent level.

Appendix B: Costs

All costs are in 1992 dollars. For each university, Rathje (2000) obtains the total operating costs, faculty operating costs, and enrollment figures. She subtracts faculty expenses and graduate studies expenses from the total operating cost of the university, then, following Allen's (1998) procedure, multiplies the remaining figure by 67 percent, as this amount is attributable to actual "teaching" costs of the university. The remaining 33 percent of costs are attributed to costs for research and community service; under the user-pay theory (that students should pay for costs of their education), these costs are not attributable to the student, and should be deducted from the total costs of education.[10] The resulting teaching cost is divided by the full-time equivalent enrollment (FTE)[11] of the university to come up with an operating cost per FTE student. Similarly, the graduate studies expense, which is assumed to be mostly the administrative cost of operating the graduate program, is taken in its entirety. This expense is then divided by the FTE enrollment of graduate students to come up with a cost per FTE for graduate programs only. The FTE operating costs for both the total expenses and

10 It may be useful to note here that the assumption that all programs have the same average percentage of research and capital costs (33 percent) means that the capital costs may be overstated in some programs and understated in others. For example, the capital costs of an engineering or science program, which requires labs and research facilities, may be higher than 33 percent of the total operating costs, while programs such as humanities or fine arts may have less than 33 percent of total costs attributable to capital. The over- or underestimation of research and capital costs will bias the resulting rates of return and the net present values downward (or upward). Similarly, research capital subsidizes operating costs, so science and technical programs, which have larger amounts of research capital, have higher subsidized operating costs than the less technical programs, resulting in rates of return that may be biased upward.

11 FTE = number of full-time enrolled students + (0.25 × number of part-time undergraduate students) + (0.33 × number of part-time graduate students). For example, a full-time undergraduate student would represent 1 FTE student. A part-time graduate student would represent 0.33 FTE student. This calculation is based on the assumption that part-time students do not use as much of a university's facilities as full-time students.

the graduate expenses for each of the seven universities considered is averaged to estimate an average operating cost for Canada.

The faculty-specific costs are calculated in a similar fashion. We assume 67 percent of the faculty expense to be teaching costs only; this amount is taken and divided by that faculty's weighted full-time equivalent (WFTE) number of students to come up with a cost per WFTE at the bachelor's level.[12] Since the weighting system assumes that master's and PhD degrees are four and six times more expensive, respectively, than a bachelor's degree (Allen 1998), the cost per WFTE is multiplied by four or six to calculate the cost per year of each master's or PhD student. Again, the WFTE operating costs for each program considered for each of the seven universities is averaged to estimate an average program cost for Canada.

As indicated in the main text, the operating expenses payable by the individual are not the same as those payable by society outlined above. The private operating expenses are represented by the tuition fees, which are only a fraction of total university operating costs. The annual tuition costs used here are for the 1998-99 academic year; for the purposes of the IRR calculations, they were converted to 1992 dollars.

The costs used in the rate of return calculations are shown in Tables B-1 through B-6.

12 WFTE = (number of full-time bachelor's students) + (0.25 × number of part-time bachelor's students) + (4 × [number of full-time master's students + 0.33 × number of part-time master's students]) + (6 × [number of full-time PhD students + 0.33 × number of part-time PhD students]). For example, an individual who is a full-time undergraduate student would represent 1 WFTE student. A part-time graduate student would represent 1.32 (= 4 × 0.33) WFTE student; a part-time PhD student would represent 2 (= 6 × 0.33) WFTE student. This is based on the assumption that part-time students would not be using as many of the facilities or as much of a professor's time as a full-time student.

Table B-1: ***Social Costs for a Bachelor's Degree***

	Annual Costs				Total Cost of Education, Males	Total Cost of Education, Females
	Forgone Earnings, Males	Forgone Earnings, Females	Books and Supplies	Operating Costs		
			(dollars)			
Education	7,776	7,197	758	7,700	64,936	62,620
Humanities	7,776	7,197	643	8,579	67,992	65,676
Agriculture	7,776	7,197	643	9,427	71,384	69,068
Commerce	7,776	7,197	758	8,094	66,512	64,196
Fine arts	7,776	7,197	1,009	9,986	75,084	72,768
Engineering	7,776	7,197	859	8,326	67,844	65,528
Nursing	7,776	7,197	792	8,915	69,932	67,616
Health	7,776	7,197	792	8,714	69,128	66,812
Science	7,776	7,197	643	8,775	68,776	66,460
Social sciences	7,776	7,197	734	7,756	65,064	62,748

Source: Rathje 2000.

Table B-2: ***Social Costs for a Master's Degree***

	Annual Costs				Total Cost of Education, Males	Total Cost of Education, Females
	Forgone Earnings, Males	Forgone Earnings, Females	Books and Supplies	Operating Costs		
			(dollars)			
Education	9,291	10,534	758	16,334	52,766	55,252
Humanities	8,836	9,682	643	19,853	58,664	60,356
Agriculture	9,416	9,344	643	23,224	66,566	66,422
Commerce	10,909	10,476	758	17,914	59,162	58,296
Fine arts	8,109	8,756	1,009	25,481	69,198	70,492
Engineering	12,000	11,340	859	18,839	63,396	62,076
Nursing	8,573	11,256	792	21,194	61,118	66,484
Health	10,364	11,388	792	22,156	66,624	68,672
Science	11,014	11,180	643	20,634	64,582	64,914
Social sciences	10,259	9,846	734	16,561	55,108	54,282

Source: Rathje 2000.

Table B-3: *Social Costs for PhD and Medical Degrees*

	Annual Costs				Total Cost of Education, Males	Total Cost of Education, Females
	Forgone Earnings, Males	Forgone Earnings, Females	Books and Supplies	Operating Costs		
			(dollars)			
Education	12,385	14,905	758	21,217	137,440	147,520
Humanities	9,804	11,866	643	26,495	147,768	156,016
Agriculture	10,471	10,893	643	31,582	170,784	172,472
Commerce	15,540	15,567	758	23,587	159,540	159,648
Fine arts	10,355	10,022	1,009	34,937	185,204	183,872
Engineering	13,758	11,975	859	24,975	158,368	151,236
Nursing	11,010	13,633	792	28,507	161,236	171,728
Health	14,341	13,674	792	27,304	169,748	167,080
Science	12,470	13,194	643	27,667	163,120	166,016
Social sciences	12,661	12,956	734	21,558	139,812	140,992
Medicine	11,014	11,180	1,461	100,828	453,212	453,876

Source: Rathje 2000.

Table B-4: *Private Costs for a Bachelor's Degree*

	Annual Costs				Total Cost of Education, Males	Total Cost of Education, Females
	Forgone Earnings, Males	Forgone Earnings, Females	Books and Supplies	Tuition Fees, Each Year		
			(dollars)			
Education	6,857	6,513	758	3,332	43,788	42,412
Humanities	6,857	6,513	643	3,201	42,804	41,428
Agriculture	6,857	6,513	643	3,138	42,552	41,176
Commerce	6,857	6,513	758	3,873	45,952	44,576
Fine arts	6,857	6,513	1,009	3,282	44,592	43,216
Engineering	6,857	6,513	859	3,382	44,392	43,016
Nursing	6,857	6,513	792	3,278	43,708	42,332
Health	6,857	6,513	792	3,293	43,768	42,392
Science	6,857	6,513	643	3,221	42,884	41,508
Social sciences	6,857	6,513	734	3,207	43,192	41,816

Source: Rathje 2000.

Table B-5: ***Private Costs for a Master's Degree***

	Annual Costs						
	Forgone Earnings, Males	Forgone Earnings, Females	Books and Supplies	Tuition Fees, 1st Year	Tuition Fees, 2nd Year	Total Cost of Education, Males	Total Cost of Education, Females
				(dollars)			
Education	6,782	7,690	758	3,590	1,093	19,763	21,579
Humanities	6,451	7,068	643	3,590	1,093	18,871	20,105
Agriculture	6,874	6,821	643	3,836	923	19,793	19,687
Commerce	7,964	7,674	758	4,531	1,745	23,720	23,140
Fine arts	5,960	6,392	1,009	3,590	1,093	18,621	19,485
Engineering	8,760	8,278	859	3,590	1,093	23,921	22,957
Nursing	6,259	8,217	792	3,590	1,093	18,785	22,701
Health	7,566	8,314	792	3,564	1,067	21,347	22,843
Science	8,040	8,161	643	3,590	1,093	22,049	22,291
Social sciences	7,489	7,188	734	3,590	1,093	21,129	20,527

Source: Rathje 2000.

Table B-6: ***Private Costs for PhD and Medical Degrees***

	Annual Costs								
	Forgone Earnings, Males	Forgone Earnings, Females	Books and Supplies	Tuition Fees, 1st Year	Tuition Fees, 2nd Year	Tuition Fees, 3rd Year	Tuition Fees, 4th Year	Total Cost of Education, Males	Total Cost of Education, Females
					(dollars)				
Education	9,041	10,849	758	3,533	1,021	948	949	45,647	52,879
Humanities	7,157	8,663	643	3,533	1,021	948	948	37,650	43,674
Agriculture	7,644	7,952	643	3,849	1,021	948	948	39,914	41,146
Commerce	11,132	11,143	758	3,532	1,019	947	947	54,005	54,049
Fine arts	7,559	7,316	1,009	3,533	1,021	948	948	40,722	39,750
Engineering	10,044	8,742	859	3,533	1,021	948	948	50,062	44,854
Nursing	8,037	9,952	792	3,533	1,021	948	948	41,766	49,426
Health	10,469	9,982	792	3,533	1,021	948	948	51,494	49,546
Science	9,103	9,632	643	3,533	1,021	948	948	45,434	47,550
Social sciences	9,242	9,458	734	3,533	1,021	948	948	46,354	47,218
Medicine	8,040	8,161	1,461	6,334	5,685	4,347	4,176	58,546	59,030

Source: Rathje 2000.

References

Allen, Robert C. 1998. "The Employability of University Graduates in the Humanities, Social Sciences, and Education: Recent Statistical Evidence." University of British Columbia. Mimeographed.

———. 1999. "Education and Technological Revolutions: The Role of Social Sciences and Humanities in the Knowledge Based Economy." Social Sciences and Humanities Research Council. Mimeographed. Available at Internet website: www.sshrc.ca.

Constantos, Christos, and Edwin G. West. 1991. "Measuring Returns from Education: Some Neglected Factors." *Canadian Public Policy* 17 (2) 127–138.

Davenport, Paul. 1996. "Deregulation and Restructuring in Ontario's University System." *Canadian Business Economics* 4 (July–September): 27–36.

Dodge, David A., and David A.A. Stager. 1972. "Economic Returns to Graduate Study in Science, Engineering and Business." *Canadian Journal of Economics* 5: 182–198.

Donnelly, Maureen, Robert Welch, and Allister Young. 1999. "Registered Education Savings Plan: A Tax Incentive Response to Higher Education Access." *Canadian Tax Journal* 47 (1): 81–109.

Rathje, Kelly Ann. 2000. "Rates of Return to Advanced Education in Alberta and Canada." Calgary: University of Calgary Master's thesis. Unpublished.

Statistics Canada. 1986. *Census Public Use Microdata File on Individuals*. Ottawa.

———. 1991. *Census Public Use Microdata File on Individuals*. Ottawa.

———. 1996. *Census Public Use Microdata File on Individuals*. Ottawa.

University of Calgary. 1996. Office of Institutional Analysis. *The University of Calgary Fact Book 1995-96*. Calgary.

———. 1997. Office of Institutional Analysis. *The University of Calgary Fact Book 1996-97*. Calgary.

University of Manitoba. 1997. Office of Institutional Analysis. 1997. *IS Book: Institutional Statistics*, 23rd ed., *1996-1997*. Winnipeg.

University of Saskatchewan. 1996. University Studies Group. *University of Saskatchewan Statistics*, vol. 22. Regina.

Vaillancourt, François. 1995. "The Private and Total Returns to Education in Canada, 1985." *Canadian Journal of Economics* 28 (3): 532–554.

———, and Irene Henriques. 1986. "The Returns to University Schooling in Canada." *Canadian Public Policy* 12 (3): 449–458.

Comments on Chant and Gibson, Finnie, Vaillancourt and Bourdeau-Primeau, and Rathje and Emery

Jeffrey Smith

I have the happy task of commenting on four fine bits of empirical economics related to higher education in Canada. My discussion is divided into three parts. First, I discuss the three papers on the general theme of returns to higher education, either overall or to particular courses of study at the undergraduate level — namely, those of Finnie, Rathje and Emery, and Vaillancourt and Bourdeau-Primeau. In the next section, I discuss Chant and Gibson's novel study of research productivity at Canadian universities. Finally, I draw some links from these papers back to the themes raised in David Laidler's introduction to this volume, and suggest some profitable avenues for future research on higher education in Canada.

Returns to University Education and to Particular Fields of Study

The three essays on the returns to higher education in general and to various fields of study present evidence that higher education is a "good buy" both for society and for the individuals who undertake it. In this context, a good buy means that the discounted present value of education's labor market payoff exceeds the discounted value of its social or individual cost, respectively. Two of the papers also present evidence that certain fields of study — mainly those that include a strong technical component or prepare students directly for particular well-defined careers — yield better labor

market outcomes than others. The findings outlined in these three papers generally comport with those in the existing literature for both Canada and the United States for earlier cohorts. These papers also extend the existing literature in various directions with, for example, Rathje and Emery paying closer attention to the details of the cost and tuition data than has been the norm. Finnie's somewhat startling (for economist readers, in any case) analysis of students' satisfaction with their chosen fields of study also represents a new finding.

Selection Bias

The findings in these essays all spring from relatively straightforward statistical analyses. What is tricky is determining what they mean, both in scientific and policy terms. The first important consideration in regard to all three essays is that students choose their fields of study. Imagine for a moment a counterfactual world in which students arrived at university and, after partying their way through orientation week, got assigned at random to a particular field of study. In this imaginary world, the field-of-study effects estimated in these essays would represent true causal effects — they would indicate the effect of studying in a given field on any randomly selected student.

Now consider instead our actual world. In the world that generated the data used in these essays, students select themselves into particular fields of study based on their goals, interests, and aptitudes, subject in some cases to entrance requirements or capacity constraints. In this world of nonrandom selection, the field effects measured in these essays combine the causal effects of the fields of study with differences across fields in factors that would affect the labor outcomes of students regardless of what they chose to study. These factors include ability, motivation, quality of primary and high school education, parental background, family environment, and so on. Casual empiricism suggests, for example, that some of the high returns reported for technical fields such as computer science and engineering actually represent returns to ability, specifically mathematical ability, that would likely also have a high return in other areas. That is to say, if, for example, you took all the com-

puter science students and switched them with all of the economics students, the returns to economics as measured in these essays would increase, while the returns to computer science would fall.

The simplest way to disentangle the effects of nonrandom self-selection into fields of study is to collect data on as many of these factors as possible and then include them in the regression equation as conditioning variables. In this way, you get the effects of various fields of study on later earnings, "holding constant" the observable characteristics of the students. Unfortunately, no existing Canadian data sets provide information on labor market outcomes, field of study in university, and the various factors likely to affect both of these areas. Constructing such a data set, or adding the necessary questions to an ongoing data set such as the Survey of Labour and Income Dynamics, would greatly improve the evidence available on which to base higher education policy in Canada.

In the absence of better data, we can still reason indirectly. Students care a lot about their labor market outcomes following graduation. They also have at least some knowledge of the type of evidence regarding returns to different fields of study presented here by Vaillancourt and Bourdeau-Primeau, and by Finnie. Given this fact, if the differences among fields of study in later earnings represent causal effects and are not just an artifact of the non-random selection of students, we would expect a migration of students into the fields with higher labor market payoffs. Yet, in stark contrast to this prediction, Finnie reports in his paper an astounding stability in the fraction of students selecting the various fields of study over the three cohorts (spanning eight years) that he considers. I read Finnie's findings on stability in the distribution of fields of study as indicating that all, or almost all, of the differences that he and Vaillancourt and Bourdeau-Primeau estimate do not represent the causal effects of particular fields of study. Rather, they indicate a substantial nonrandom sorting of more able, better-prepared, or more motivated students into particular fields.

Capacity constraints represent one potential alternative explanation for the higher estimated returns to fields such as computer science. At some schools, the number of slots in these fields is limited. Such limits have two effects. First, to the extent that migration into Canada is not costless, so that immigrants do not represent

perfect substitutes, and to the extent that students from other fields are not perfect substitutes either, capacity constraints raise the labor market return received by students in the constrained majors by artificially reducing their supply in the labor market.

This effect holds even if the limited slots are allocated by lottery, so that no additional selection is induced. But of course, most programs with capacity constraints do not allocate slots by lottery but rather by some measure of ability and effort, such as performance in various screening courses. This is the second effect of limiting the number of slots, and it creates an obvious bias in the estimated returns to the field of study by deliberately inducing the type of nonrandom sorting already discussed. What we lack in regard to this explanation, however, is evidence. A very useful endeavor for a graduate student would be to collect data on the capacity constraints and slot allocation rules in place in universities across Canada. These data, when compared to the estimated returns by discipline, would allow an evaluation of the relative importance of this factor in explaining the observed differences.

Individual Heterogeneity and the Question of Interest

Heterogeneity is the second important factor to keep in mind in interpreting the findings of the three papers on returns to postsecondary education and to fields of study within university programs. It seems quite likely that the effects of going to a university at all, as well as the effects of particular majors within university, will differ among individuals. One person might flourish in a university environment while another might find the experience stultifying and baffling. One person might discover an important new material while studying chemical engineering, while another might discover only that you should not spill acid on your lap.

To the extent that individuals have some idea about how much they would benefit from making different choices about university attendance and field of study, we would expect them to sort themselves accordingly. Thus, the set of persons we observe attending university should, on average, benefit more from it than would the

set of persons not attending university. The same holds true among fields of study: we would expect that the students currently majoring in, say, economics believe they will benefit more from it than they would from another choice of field.

Thinking about heterogeneity in this way has important implications for how we interpret the estimates presented in the three essays under discussion. In particular, we must take care to formulate the question of interest exactly. One potentially interesting question concerns the effects of going to university, or of choosing a particular field of study, on those presently observed to make these choices. For example, we might ask what the return is to studying engineering for those who presently do so. A different question, one that in a world of heterogeneous returns would have a different answer, consists of the effect of studying engineering on those who would be induced to do so in response to particular policy changes. Simple economics suggests that students induced to choose engineering at the margin by a policy change will benefit less from it, on average, than those who chose it prior to the policy change. Similarly, in the absence of credit constraints, we would expect that students on the margin between attending university and not will reap lower rewards, on average, from doing so than students who would attend even if the price were much higher. To make things even more complicated, the same students need not be the marginal ones for all policy reforms. For example, the marginal student who would be induced to attend university by a reduction in tuition may differ from the marginal student induced to attend by the introduction of an income-contingent loan program. Identifying the correct margins for particular policy reforms, and estimating the effects at those margins, remains an important topic for future research. The interested reader should consult Card (1999) and Heckman and Vytlacil (1998) for more technical presentations of these ideas.

Compensating Differences and Mediating Variables

One of the ways in which economics helps our thinking is by providing useful base states against which to compare the actual world.

Simple economics would suggest that, given reasonably good information and in the absence of capacity constraints, the marginal university student should be indifferent to the choices of attending and not, and the marginal student in each field of study should be indifferent to the choice between that field and his or her next best alternative. Yet the estimated rates of return to a university education in general and to particular fields of study presented in these three papers seem to contradict this simple economic model; university has a large positive private return and some fields of study yield much higher labor market earnings than others.

Why does reality fail to match the simple model? The differences between marginal and average returns play a key role, as has already been discussed. Another important factor, however, consists of the nonmonetary returns to both university educations and to fields of study. The simple economic model does not imply that marginal individuals would have the same monetary return to the alternatives they face, but rather that they expect to receive the same utility from them.

This point about what exactly should be equalized at the margin has two aspects. First, casual observation suggests that different fields of study imply different mixes of consumption and investment while in school. If on a Friday night we surveyed both the students in the university library and those at the local dance club, we would find differences in the two distributions of fields of study. In addition to differences in the time and effort required to complete particular degrees, some fields of study involve activities that most people enjoy, such as reading novels, while others involve activities that most people do not enjoy, such as solving differential equations. We would expect these differences among fields during university to be compensated for in the labor market after university.

Second, different fields of study typically lead to different jobs, and those different types of jobs vary in their nonmonetary compensation. Some jobs involve lots of travel, flexible hours, and interesting colleagues. Other jobs involve being outdoors. Still others involve high levels of stress. Indeed, there is a whole literature in labor economics, ably surveyed by Rosen (1986), on the subject of compensating differences — the extent to which persons in jobs with less desirable characteristics receive a wage premium to com-

pensate them. Studies that look only at monetary compensation overstate the differences between fields to the extent that such compensating differences play an important role in labor market outcomes.

A related issue, which has particular relevance to returns to education for women, is differences across education levels and among fields of study in employment and unemployment rates. A standard finding of studies in virtually every developed country is that unemployment rates fall — and employment rates rise — with the level of schooling. Thus, part of the difference in earnings between high school graduates and university graduates arises from the fact that the latter group will spend, on average, more of its time working and less of it being unemployed or out of the labor force. Studies that leave out the "zeros" — that is, studies that omit persons with zero earnings, as do all three studies in this book — miss part of this component of the effect of university completion. They do not miss all of it, because some of those who work less as high school graduates than they would have as university graduates still have positive earnings. Studies that use questions based on annualized earnings, such as Finnie's, miss more of this employment effect than studies that rely on actual earnings as their dependent variable.

Increased employment is not an unambiguous good, of course, particularly for the individual decisionmaker. More work means less leisure. Such tradeoffs complicate individual cost-benefit calculations related to university attendance and field of study. These employment effects are likely to be particularly important for women, who exhibit much more flexibility in their labor supply than do men in the years immediately following university completion. These differential employment effects may help to account for the somewhat surprising differences in returns to different fields of study between men and women. It would be an interesting research exercise to decompose the effects for both men and women into effects on employment and effects on earnings conditional on employment.

General Equilibrium Effects

Large policy changes have large effects — effects that work through the entire economy in different ways. In the current context, the

most important of these so-called general equilibrium effects consist of changes in relative skill prices in response to policies that change the mix of skills produced by the educational system. For example, consider a move from the current regime of heavily subsidized tuition to a regime combining higher tuition, more reflective of the costs of providing a university education, with an expanded government student loan program. Such a reform would raise the private cost of attending university and should thereby reduce the number of students who do so. This in turn would diminish the supply of university-educated labor, which would have the countervailing effect of raising its market price.

In this example, a failure to consider this price increase would lead to an overestimate of the negative effect of the tuition increase on university enrollment. In their study of a US program to subsidize university tuition (the policy debate in the United States is moving in the opposite direction from that in Canada in this area), Heckman, Lochner, and Taber (1998) find that taking account of changes in skill prices reduces by 90 percent the estimated impact of a subsidy on enrollment. The lesson here is that general equilibrium effects can be important, and should play a role in analyses of large-scale policies.

Some Smaller Issues

I now consider a number of smaller issues — small not necessarily in their substance but in the sense that I have only a bit to say about each one. The first concerns the inclusion or exclusion of those who go on to a graduate degree from the sample used to estimate the returns to an undergraduate degree. Finnie excludes them in his paper, but I am not sure that I would have. Consider the following imaginary scenario.

Suppose that the only reason anyone studied political science was a desire to go to law school. Once they obtained their bachelor's degree, we might then imagine, all political science graduates would immediately apply to law school. Those that get into law school go on to become lawyers (a discipline with, perhaps, externalities of a different sign from those of many others) and those that did not get

in would do something else. In this hypothetical but not completely unrealistic world, excluding persons obtaining a graduate degree would substantially understate the returns to political science, which, in my scenario, consist mainly of the returns to, perhaps, later becoming a lawyer. To return to a more general view, part of the causal effect of certain majors is a heightened probability of going on to graduate school; this effect is something both individuals and society should consider in their calculations.

The second smaller issue consists only of a reminder that none of these three studies has much in the way of longitudinal data. The two studies that use census data rely on a so-called synthetic cohort assumption to estimate the life-cycle returns to both university completion and to specific fields of study. Under this assumption, the outcomes of older persons today proxy for the outcomes that younger people today will experience when they get older. In a world of rapid change, where different cohorts have different skill mixes (and are of different sizes), this assumption may be problematic. Finnie projects earnings profiles beyond the five-year follow-up provided by his data by assuming that the age-earnings profile has a specific functional form. The functional form he adopts is not an unreasonable one, but it would be interesting to know (another topic for future research) the sensitivity of the estimates to the specific functional form he assumes.

Finally, I have a couple of remarks about taxes. First, in the presence of a nonlinear tax schedule such as the one in place in Canada, the expected value of taxes paid does not equal the number that you get by applying the tax schedule to expected income, as is done in all three studies. Second, as is well known but often ignored in cost-benefit exercises of this sort, it costs society more than a dollar to raise a dollar in tax revenue. One source of extra costs is the overhead associated with administering the tax system and with "voluntary" compliance on the part of the long-suffering Canadian taxpayer. A more important source is the set of behavioral distortions induced by the tax system, distortions that reduce the size of the pie for everyone. Estimates of these deadweight costs, or "excess burden" to use the public finance jargon, vary widely, but none of them is zero, and they are large enough in some cases to affect the social cost-benefit calculations in these papers.

Policy Implications

How do the issues raised so far affect the advisability of the various policy proposals raised in the introduction and discussed in some of the chapters?

Consider first a policy, suggested by the findings in Finnie and in Vaillancourt and Bourdeau-Primeau, of increasing the number of students undertaking technical fields of study, such as engineering. In the case of capacity-constrained disciplines this could simply mean loosening the constraints. In other cases it could mean differentially low tuition or perhaps some sort of bonus on degree completion. The arguments above about nonrandom selection into fields of study, individual heterogeneity, and general equilibrium effects all suggest that the returns realized by the new, marginal graduates who would be drawn to these fields would be lower than the estimates in this volume suggest, perhaps substantially lower. There is, as usual, no simple spell to cast in order to make all things wonderful. This does not mean that reducing capacity constraints where they exist is not a good idea; the evidence is consistent with fairly high marginal returns in some disciplines. But the reasoning here does suggest a cautious approach to expensive subsidy programs.

Now consider the policy suggested in the introduction of replacing subsidized tuition with a tuition level more reflective of the costs of providing the education, combined with a more extensive student loan program. The reasoning above about the heterogeneous effects of university suggests that such a reform would reduce the total number of university students, as at the margin some students who previously found it privately worthwhile to attend no longer will. This would (through a compositional effect) increase the average return among those still attending. Whether this is a good or a bad idea in efficiency terms depends on the extent of the externalities associated with university education; keep in mind that those externalities may well be lower for students on the margin between attending and not attending.

Next, consider the very popular recent proposal of a system of higher tuitions combined with income-contingent student loans (loans in which the amount students have to pay back depends in part on how much they make after graduation). Such a reform

would have several effects. First, it would increase the relative attractiveness of disciplines that have a high consumption value, leading, one would predict, to more crowded campus pubs and emptier libraries. Second, it would increase the relative attractiveness of majors that lead to jobs with relatively high nonmonetary compensation. This is because the income contingency in the loan payments would increase the tax rate on monetary compensation but not on nonmonetary compensation. For the same reason, it should lead employers who hire university graduates to alter their compensation packages to include a higher relative level of nonmonetary compensation. Thus, we would predict lower paychecks and more corporate "retreats" in Hawaii and Whistler. Third, because the program would provide a sort of *de facto* income insurance for university graduates, it would increase the relative attractiveness of occupations with high variances in earnings. The predicted result of this factor is more athletes and artists relative to other, less variable, occupations. Finally, and perhaps most important, income-contingent loans would raise the already very high marginal income tax rate facing most university-educated workers. This would lead them to work less and enjoy more leisure. Taking all these predictions into account, I confess that I find it tough to see the point to this particular reform.

Finally, consider the related reform proposal of discipline-specific tuitions, as suggested by Rathje and Emery. The effects of this policy would depend crucially on the details of implementation. Basing tuitions on estimated earnings differences that fail to adjust for nonrandom sorting could lead to all sorts of fascinating distortions. To the extent that, for example, the higher earnings of engineers mainly reflect a sorting by ability, higher tuition for this discipline would chase people out of engineering, as the more able could now make more, net of tuition, doing other things. The less able did not find engineering worthwhile before, so they certainly would not with a higher tuition. Such a system would also require periodic updating in response to general equilibrium effects, as the supply changes in response to the initiation of the system would act to change the earnings effects associated with different fields of study, which would then require further changes in the tuition levels, and so on. Technology shocks affecting the relative demands

for different skills would also lead to a need for updating tuition levels.

Setting tuition levels based on program costs raises another set of issues. In this regard, it is worth noting (and studying further) the fact that private universities in the United States, which can set their tuitions however they like, in fact set more or less standard tuitions for undergraduate education in any field, and then price discriminate like mad based on family income and assets. This behavior suggests that there may be good reasons for not differentiating tuition too finely by discipline — such as the administrative costs of keeping track of the tuition level for students who wander through four or five majors before settling on the one they will ultimately finish. Students would also have an incentive to exploit such a system by switching at the last possible moment from a low-tuition field to a high-tuition field, so that much policing of who took what courses when would be required.

The Research Output of Canadian Universities

Chant and Gibson take their paper in a different direction from the other three discussed here. Rather than the labor market returns to a university education, they look at the research output of Canadian universities, an exceedingly important topic. This paper lays a fine foundation and provides an interesting (and intuitively plausible) finding: that Canadian universities seem to be holding their own in terms of the volume of publications but not of their impact.

Plenty remains for future work: refining the output measures; expanding the comparisons across disciplines in an attempt to explain differences in performance across time and in the cross section; and delving further inside the black box of particular disciplines that may provide especially useful insight.

In regard to the first of these research areas — refining output measures — the most obvious refinement would be to weight both publications and citations by journal quality. At least in some disciplines, such as economics, relatively standard rankings of journal quality should be available. The arduous part of the task, obviously, would be combining these rankings with the publication and

citation data. I suspect that the same basic picture will emerge, but the question is important enough that getting all the details down deserves researcher time and attention.

In regard to the second direction for future research, it is notable that the authors find some fairly wide swings over time in the rankings for particular disciplines. It would be nice to try to link those swings to observable characteristics of the discipline — in particular, to whether or not it operates in an international labor market. If the labor market for a discipline is confined largely to Canadians, then it can better retain its quality in the face of rising salaries in the United States, the United Kingdom, and elsewhere. Other field characteristics worth examining would include the location of the top doctoral programs in the world. Presumably, fields in which one or more of the top doctoral programs is found in Canada will have an easier time retaining quality faculty in the face of labor market competition.

In regard to the final suggested research direction I mentioned, a look at particular disciplines, I offer the somewhat self-serving suggestion that a detailed examination of the case of economics would provide some useful lessons. The economics profession has a truly international labor market. As a result, many economists at Canadian universities are not Canadian by birth, and many of the best-known Canadian economists work at US universities. As is well known within the profession, in recent years the low exchange rate for the Canadian dollar, combined with provincial budget problems, has led to a lot of departures for warmer and more remunerative climes. Studying this field in detail to learn "what went wrong" could provide guidance in reducing the impact of similar changes on fields that may be earlier on in the process.

Concluding Remarks

I now return to some of the main themes raised by David Laidler in his fine introduction to this volume, and then offer up a short list of topics related to higher education in Canada that deserve further research attention. It goes without saying that evidence-based policy-making requires evidence. This volume provides a wealth of evidence on several important questions, but much work remains to be done

on these questions to provide the knowledge base required for making coherent and effective higher education policy.

As Laidler notes, the two primary economic justifications for government intervention in higher education markets are externalities and credit constraints. We know very little about externalities, but we could learn more through some clever research on the topic. While it is handy for those of us who make our living in the higher education sector to point to the shimmering hope of externalities to justify our funding, the taxpayer would be better served with some hard empirical estimates.

A lively literature already exists, however, on the subject of credit constraints. Most of it focuses on the United States, but the institutions and participation levels are similar enough that it can probably be generalized to Canada. Two notable recent contributions are Cameron and Heckman (1998) and Stinebrickner and Stinebrickner (2001). Both suggest that, given the current institutional setup and funding levels in the United States, credit constraints are less important than is commonly thought. There does not appear to be a large pool of smart kids being kept away from university by funding issues, nor does it appear that credit constraints alone account for higher rates of dropping out among students from low-income families. This evidence does not necessarily indicate that current student funding programs should be eliminated, but it suggests little need for expansion beyond the levels currently provided in the United States and Canada.

A third broad issue, one that has received relatively little attention in either the United States or Canada, is the rationale for having government operate universities. Consider a system like that outlined in the introduction, in which schools set their own tuition in a competitive higher educational marketplace, and students shop for the school that best matches their needs in the context of a system of government-guaranteed student loans. In such a regime, one could find economic justifications for government to subsidize research, particularly basic research, and to provide student loans and perhaps grants. But no obvious economic justification exists, in either this hypothetical regime or the existing one, for having government actually operate universities. Both theoretical research on why and how we would expect public and private uni-

versities to behave differently, and empirical research comparing public and private universities in the United States or using historical data from the period prior to the socialization of Canadian universities, would have great value.

I now offer some additional policy-related topics that would repay further research attention. First, and perhaps most important, one of the main characteristics that differentiate Canadian from US universities is that the faculty at many Canadian universities, even some fairly good ones, is unionized. Several questions arise immediately. Why has this occurred in Canada and not in the United States? Is it because of differences in labor laws? Or some difference in the way in which public universities operate in the two countries? Is it the lack of private sector competition in Canada? What are the likely effects of unionization in Canada over the long term on research output and quality, and on instructional quality? One hears many anecdotes and horror stories, but systematic evidence is largely lacking.

Second, Canadian higher education has a number of other distinctive features not present in the US system. One is the strong separation between honors and general degrees, with, at least in Ontario, an extra year spent obtaining the honors degree. These honors programs are expensive in terms of faculty time but provide a higher quality undergraduate education to the cream of the undergraduate population. In economics, at least, such degrees appear to carry a labor market premium. Is that premium sufficient to justify the extra cost?

Finally, three quick topics for consideration within the context of the current government-operated university system. First, what value, if any, would there be to spending the money it would require to have a true "Harvard of Canada" — that is, a Canadian university of the same research stature as one of the elite private or public universities in the United States. Second, and not unrelated, what is the effect of university quality — as measured by, for example, the variables employed in the annual *Maclean's* rankings — on labor market outcomes? An as yet unpublished paper by Betts, Ferrall, and Finnie (2001) examines this question, and finds some labor market effects of quality-related university characteristics for male Canadian graduates. Further research, particularly of a kind

that was allowed to "name names" by indicating the relative labor market performance of specific universities, would be helpful in thinking about the optimal array of qualities to provide within the public system. Third, and also related, we now know something about the extent of peer effects in university education from the US literature on the effects of peer quality measures on labor market outcomes (see, for example, Datcher Loury and Garman 1995). What do these findings imply for the centralized student allocation mechanism presently used in Ontario? Could changes in the assignment rules increase overall educational attainment?

References

Betts, Julian, Christopher Ferrall, and Ross Finnie. 2001. "The Role of University Quality in Determining Post-Graduation Outcomes: Panel Evidence from Three Recent Canadian Cohorts." University of California at San Diego. Unpublished manuscript.

Cameron, Stephen, and James Heckman. 1998. "Life Cycle Schooling and Dynamic Selection Bias: Models and Evidence for Five Cohorts of American Males." *Journal of Political Economy* 106 (2): 262–333.

Card, David. 1999. "The Causal Effect of Education on Earnings." In Orley Ashenfelter and David Card, eds., *Handbook of Labor Economics*, vol. 3A. Amsterdam: North-Holland.

Datcher Loury, Linda, and David Garman. 1995. "College Selectivity and Earnings." *Journal of Labor Economics* 13 (2): 289–308.

Heckman, James, Lance Lochner, and Christopher Taber. 1998. "Explaining Rising Wage Inequality: Explorations with a Dynamic General Equilibrium Model of Labor Earnings with Heterogeneous Agents." *Review of Economic Dynamics* 1 (1): 1–58.

———, and Edward Vytlacil. 1998. "Instrumental Variables Methods for the Correlated Random Coefficient Model." *Journal of Human Resources* 33 (4): 974–987.

Rosen, Sherwin. 1986. "The Theory of Equalizing Differences." In Orley Ashenfelter and Richard Layard, eds., *Handbook of Labor Economics*, vol. 1. Amsterdam: North-Holland.

Stinebrickner, Todd, and Ralph Stinebrickner. 2001. "The Relationship between Family Income and Schooling Attainment: Evidence from a Liberal Arts College with a Full Tuition Subsidy Program." London, Ont.: University of Western Ontario. Unpublished manuscript.

The Contributors

Sandrine Bourdeau-Primeau holds a BSc (Honours) in Economics and Mathematics and an MSc in Economics from the Université de Montréal. She worked as a research assistant on human resources issues for the university's Centre de recherche et développement en économique and is currently employed as an economist with the Department of Fisheries and Oceans in Ottawa.

Joel Bruneau is an Assistant Professor at the University of Saskatchewan, where he teaches Resource and Environmental Economics, International Trade, and Microeconomics. He was born in Yellowknife, NWT, and after high school moved to Saskatchewan, where he found the prairie winters both warm and short. He has a BA and MA in Economics from the University of Saskatchewan and a PhD from the University of British Columbia.

John Chant has a BA from the University of British Columbia and a PhD from Duke University. He taught at the University of Edinburgh, Duke University, Queen's University, and Carleton University, before going to Simon Fraser University in 1979, where he was Chair of the Department of Economics. He served as the Director of the Financial Markets Study Group at the Economic Council of Canada and as Research Director of the Task Force on the Future of the Canadian Financial Services Sector (the MacKay task force). He has written widely on such topics as the Bank of Canada, the theory of financial intermediation, and the regulation of financial institutions. Professor Chant is now serving as Special Adviser at the Bank of Canada.

Paul Davenport is President of the University of Western Ontario and Professor of Economics there. He taught economics at McGill University (1973–89), and was President of the University of Alberta from 1989 to 1994. He served as Chair of the Association of Canadian Universities and Colleges of Canada (1997–99) and Chair of

the Council of Ontario Universities (1999–2001). A graduate of Stanford University (BA, with Great Distinction) and the University of Toronto (MA, PhD), he has honorary degrees from the University of Alberta (1994) and the University of Toronto (2000), and in 2001 was named Chevalier de la Légion d'Honneur by the government of France. His research in economics has centered on economic growth, fiscal federalism, and the knowledge-based economy.

Stephen T. Easton is Professor of Economics at Simon Fraser University, where he has taught since 1975. A graduate of the University of Chicago, he is the author of *Education in Canada* (Fraser Institute, 1988), and was series editor for a set of monographs on education published by the Institute for Research of Public Policy. His work on secondary schooling inspired the popular Fraser Institute Report Cards on secondary education for British Columbia, Alberta, Quebec, and Ontario. He currently serves as Chairman of the Board of the Society for the Advancement of Excellence in Education, and is a Senior Scholar at the Fraser Institute.

J.C. Herbert Emery received his PhD (Economics) from the University of British Columbia in 1993. Since then, he has taught in the Economics Department at the University of Calgary, where he is currently an Associate Professor and Director of the Research Unit for the Study of Civil Society. His research has primarily been in the fields of economic history and labor economics.

Ross Finnie was educated at Queen's University, the London School of Economics, and the University of Wisconsin, where he received his PhD. For the past five years, he has been a Research Fellow and Adjunct Professor in the School of Policy Studies at Queen's, and a Visiting Fellow at Statistics Canada. His research interests include the labor market experiences of postsecondary graduates, student debt and the financing of postsecondary education, and the brain drain. His publications for the C.D. Howe Institute include "Measuring the Load, Easing the Burden: Canada's Student Loan Programs and the Revitalization of Canadian Postsecondary Education" (November 2001); and *Student Loans in Canada: Past, Present, and Future* (with Saul Schwartz, 1996).

William Gibson holds a PhD in economics from Simon Fraser University. He has taught at Simon Fraser and the University of Lethbridge and has been a guest lecturer at the University of Montana and St. Cloud State in Minnesota. In addition to work on the economics of higher education, he has written on public debt, inflationary finance, Canadian economic history, and the economics of gratuities. Current interests include the economics of universities and the importance of research, government spending (and reducing it) and the corpus of public choice economics. In his spare time, he writes satire and humor and takes bird photographs.

David Laidler is Bank of Montreal Professor at the University of Western Ontario, and a Fellow-in-Residence and Canadian Bankers Association Scholar at the C.D. Howe Institute. In 1998 and 1999, he was Visiting Economist and Special Adviser at the Bank of Canada. His fields of interest are monetary economics and the history of economic thought. His most recent large-scale academic publication is *Fabricating the Keynesian Revolution: Studies of the Interwar Literature on Money, the Cycle and Unemployment* (Cambridge University Press, 1999). His book *The Great Canadian Disinflation: The Economics and Politics of Monetary Policy in Canada, 1988–93* (with William Robson, C.D. Howe Institute, 1993), was awarded the Canadian Economics Association's Doug Purvis Memorial Award for excellence in writing on Canadian economic policy.

Melville L. McMillan is a Professor in the Department of Economics and a Fellow of the Institute of Public Economics at the University of Alberta. He served as Chair of the Department from 1987 to 1997 and in various other administrative roles within the university. He has a BA and an MSc from the University of Alberta and a PhD from Cornell University. His research and teaching interests are in public economics — in particular, urban and local economics, fiscal federalism, and the demand for and supply of publicly provided goods and services. His publications include a recent article on measuring university efficiency.

Alice Nakamura holds the Francis Winspear Chair of Business at the University of Alberta. She is the academic co-chair of the Canadian

Employment Research Forum, and she heads up the Canada-wide volunteer university faculty initiative that created www.CareerOwl.ca, an Internet recruiting information system. She has published widely, and has served on numerous federal and provincial task forces and advisory committees. In 1996, Professor Nakamura received an Honorary Doctorate of Law from the University of Western Ontario, and in 1995 she served as President of the Canadian Economics Association.

Kelly A. Rathje graduated from the University of Calgary with a BA (Honours) and an MA, both in Economics. Her master's thesis, "The Rates of Return to Advanced Education in Alberta and Canada," examined the social and individual returns to postsecondary education. Since September 1999, she has been a consultant with Economica, an economic consulting firm specializing in the provision of litigation support in personal injury and fatal accident cases.

Jeffrey Smith is Associate Professor at the University of Maryland. He received his PhD in Economics from the University of Chicago in 1996 and joined the Maryland faculty in 2001. Before that he was Associate Professor and CIBC Chair in Human Capital and Productivity at the University of Western Ontario. In 1997, he received the Polanyi prize, awarded each year to an outstanding young Ontario economist. His research centers on methods for the evaluation of social programs such as job training for the disadvantaged.

François Vaillancourt is Professor of Economics in the Département de sciences économiques, Université de Montréal. He was educated at the Université de Montréal and Queen's University, where he obtained his PhD. His research interests include public economics, human resources and social behavior, and language economics. His publications for the C.D. Howe Institute include "Le statut du français sur le marché du travail au Québec, de 1970 à 1995: les revenus de travail" (with Christine Touchette, 2001); "Taxes, Transfers, and Generations in Canada: Who Gains and Who Loses from the Demographic Transition" (with Philip Oreopoulos, 1998); and *Survival: Official Language Rights in Canada* (with John Richards and William G. Watson, 1992).

Members of the C.D. Howe Institute*

Corporate and Association Members

AGF Management Limited
AON Consulting Inc.
ARC Financial Corporation
AT&T Canada
ATCO Gas Services Ltd.
Acklands Grainger
Air Canada
Alberta Chambers of Commerce
Alberta Energy Company Ltd.
Alberta Treasury Branches
Altamira Investment Services
Arthur Andersen LLP
BCE Inc.
BMO Nesbitt Burns
BP Canada
Bank of Montreal
Bank of Nova Scotia
Barrick Gold Corporation
Bell Canada
Bennett Jones
Birks Family Foundation
Bombardier Inc.
The Boston Consulting Group
Brascan Corporation
Brookfield Properties Corporation
Burgundy Asset Management Ltd.
Business Council of British Columbia
Business Development Bank of Canada
CAE Inc.
C.M. Harding Foundation
Cadillac Fairview Corporation Limited
Canada Deposit Insurance Corporation
Canada Life Assurance Company
Canada Overseas Investments Limited
Canada Post Corporation
Canadian Association of Insurance and Financial Advisors
Canadian Association of Petroleum Producers
Canadian Bankers Association
The Canadian Institute of Chartered Accountants
Canadian Council of Chief Executives
Canadian Federation of Independent Business
Canadian Finance & Leasing Association
Canadian Imperial Bank of Commerce
Canadian Life and Health Insurance Association Inc.
Canadian National
Canadian Tax Foundation
Canadian Western Bank
Candor Investments Ltd.

* The views expressed in this publication are those of the authors, and do not necessarily represent the opinions of the Institute's Board of Directors or members.

CanWest Global Communications Corp.
Capital Alliance Ventures Inc.
Cargill Limited
Citibank Canada
Clarica Life Insurance Company
Cogeco inc.
CompCorp
Crown Investment Corporation of Saskatchewan
Crown Life Insurance Company Limited
Deloitte & Touche LLP
Desjardins Ducharme Stein Monast
Deutsche Bank Canada
Dofasco Inc.
The Dominion of Canada General Insurance Company
Donner Canadian Foundation
DuPont Canada Inc.
EDCO financial Holdings Ltd.
ENSIS Growth Fund Inc.
Economap Inc.
Economic Development Edmonton
Empire Financial Group
Enbridge Inc.
Ernst & Young
Export Development Corporation
Fairmont Hotels and Resorts
Falconbridge Limited
Fidelity Investments
Finning International Inc.
Forest Products Association of Canada
Four Seasons Hotels Limited
G.T.C. Transcontinental Group Ltd.
General Electric Canada Inc.
George Weston Ltd.
Gibson Petroleum Company Limited
Gluskin Sheff + Associates Inc.
Goal Group of Companies
Goldman Sachs Canada Inc.
Goodmans
Great-West Life Assurance Company
HSBC Bank Canada
HSD Partners Inc.
Harvard Developments Limited, A Hill Company
Hergott Duval Accounting Services
Hewlett-Packard (Canada) Ltd.
Hollinger Inc.
Honeywell Limited
Hydro One Networks Inc.
IPSCO Inc.
Imperial Oil Limited
Imperial Tobacco Canada Limited
Inco Limited
Inland Group
Insurance Bureau of Canada
Investment Dealers Association of Canada
The Investment Funds Institute of Canada
Investors Group
J.P. Morgan Chase Bank
The Jackman Foundation
Jarislowsky Foundation
The John Dobson Foundation
K.P.A. Advisory Services Ltd.
KPMG LLP
Kolter Property Management Limited
La Jolla Resources International Ltd.
Lazard Canada Corporation
Lombard Canada
Maclab Enterprises
McCarthy Tétrault
McClean Watson Capital Inc.
McDonald's Restaurants of Canada Limited
McMillan Binch
Magellan Aerospace Limited
Manulife Financial
The Maritime Life Assurance Company
Marsh Canada Limited
Max Bell Foundation

Merrill Lynch Canada Inc.
Monitor Company
Moosehead Breweries Limited
Morneau Sobeco
National Bank of Canada
Nexen Inc.
Noranda Inc.
Norske Skog
Nova Chemicals Corporation
Onex Corporation
Ontario Hospital Association
Ontario Medical Association
Ontario Power Generation Inc.
Ontario Securities Commission
Ontario Teachers' Pension Plan Board
Osler, Hoskin & Harcourt
Petro-Canada
Pfizer Canada Inc.
Phillips, Hager & North Investment Management Ltd.
Pirie Foundation
Power Corporation of Canada
Pratt & Whitney Canada
PricewaterhouseCoopers LLP
Princeton Developments Ltd.
Procor Limited
RBC Dominion Securities
RBC Financial Group
Rogers Communications Inc.
Roy-L Capital Corporation
The S. Schulich Foundation
SNC Lavalin Group Inc.
The Samuel Group of Companies
Sceptre Investment Counsel
Shell Canada Limited
Sherritt International Corporation
Southam Inc.
Stikeman Elliott
Sun Life Assurance Company
Suncor Energy Inc.
Syncrude
TD Bank Financial Group
Talisman Energy Inc.
Teck Cominco Limited
Telesystem Ltd.
TELUS
Thomson Corporation
The Toronto Stock Exchange
Torstar Corporation
Torys
TransAlta Corporation
TransCanada Pipelines Limited
Utilicorp Networks Canada
VIA Rail Canada Inc.
The Westaim Corporation
Westcoast Energy Inc.
Weston Forest Corporation
William M. Mercer Limited

Individual Members

Michael J. Adams
James E. Arnett
Harry Baumann
Stanley Beck, Q.C.
Robert Birgeneau
David E. Bond
R.A.N. Bonnycastle
Pierre Brunet
Helen Burstyn
Robert C. Caldwell
Barry Campbell
Russell Campbell
Ken Christoffel
Ian D. Clark
Jack Cockwell
Marshall A. Cohen, O.C., Q.C.
E. Kendall Cork
Marcel Côté

John Crispo
Glen E. Cronkwright
Paul R. Curley
Catherine Delaney
Jean-Claude Delorme
Steven Devries
James Doak
Wendy Dobson
Bill Empey
Morrey M. Ewing
Angela Ferrante
Aaron M. Fish
Dr. James D. Fleck
L. Yves Fortier, C.C., Q.C.
Joseph F. Gill
Ross W. Glenn
Martin Goldberg
Peter Goring
Dr. John A.G. Grant
Dr. Geoffrey E. Hale
Susan J. Han
G.R. Heffernan
Lawrence L. Herman
Robert A. Hill
William Holt
H. Douglas Hunter
Lou Hyndman, Q.C.
Edwin W. Jarmain
Thomas E. Kierans
Joseph Kruger II
R. John Lawrence
Jacques A. Lefebvre
J.W.(Wes) MacAleer
W.A. MacDonald
James P. McIlroy
The Hon. Frank McKenna
Georg Marais
Bruce E. Mintz
Russell J. Morrison
Dr. F.W. Orde Morton
John P. Mulvihill, CFA
Dr. Edward P. Neufeld
James S. Palmer
Andy Perry
Philip G. Ponting
Grant L. Reuber
Nicholas Ross
Davide Rossi
David Santangeli
Guylaine Saucier
Dick Schmeelk
Hugh Segal
Lindsay Shaddy
Gordon Sharwood
Philip Spencer, Q.C.
James Stanford
Wayne Steadman
Harry Swain
Christopher Sweeney
Thomas Symons
Frederick H. Telmer
Bruce Terry
Robert J. Turner
G. Douglas Valentine
Jack H. Warren
David J. S. Winfield
Alfred G. Wirth
Adam H. Zimmerman

Honorary Members

G. Arnold Hart
David Kirk

Recent Publications of the C.D. Howe Institute

Dobson, Wendy. "Shaping the Future of the North American Economic Space: A Framework for Action." *C.D. Howe Institute Commentary* 162 (April 2002). $12.00; ISBN 0-88806-551-5.

Richards, John. "The Paradox of the Social Union Framework Agreement." *C.D. Howe Institute Backgrounder* 59 (March 2002). 9 pp.; $3.00; ISBN 0-88806-553-1.

Aba, Shay. "Good Policies for Bad Times." *C.D. Howe Institute Backgrounder* 58 (March 2002). 8 pp.; $3.00; ISBN 0-88806-555-8.

Palmer, John P. "Bread and Circuses: The Local Benefits of Sports and Cultural Businesses." *C.D. Howe Institute Commentary* 161 (March 2002). 18 pp.; $10.00; ISBN 0-88806-545-0.

Slack, Enid. "Municipal Finance and the Pattern of Urban Growth." *C.D. Howe Institute Commentary* 160 (February 2002). 25 pp.; $10.00; ISBN 0-88806-544-2.

Jaccard, Mark. "California Shorts a Circuit: Should Canadians Trust the Wiring Diagram?" *C.D. Howe Institute Commentary* 159 (February 2002). 27 pp.; $10.00; ISBN 0-88806-546-9.

Laidler, David, and Shay Aba. "Productivity and the Dollar: Commodities and the Exchange Rate Connection." *C.D. Howe Institute Commentary* 158 (February 2002). 15 pp.; $10.00; ISBN 0-88806-549-3.

Donaldson, Cam, Craig Mitton, and Gillian Currie. "Managing Medicare: The Prerequisite to Spending or Reform." *C.D. Howe Institute Commentary* 157 (January 2001). 20 pp.; $10.00; ISBN 0-88806-540-X.

Milligan, Kevin. "Quebec's Baby Bonus: Can Public Policy Raise Fertility?" *Backgrounder* (January 24, 2002). 9 pp.; free of charge.

Herman, Lawrence L. "Softwood Lumber: The Next Phase." *Backgrounder* (December 6, 2001). 6 pp.; free of charge.

Goldfarb, Danielle. "Who Gets CIDA Grants? Recipient Corruption and the Effectiveness of Development Aid." *Backgrounder* (November 29, 2001). 12 pp.; free of charge.

RENOVATING THE

IVORY TOWER

Canadian Universities and the Knowledge Economy

David Laidler,
editor

Change is the order of the day in the Canadian economy. Phrases such as the "new economy" and the "knowledge economy" have become commonplace in discussions of economic policy. In such an environment, new ideas – and a highly skilled, adaptable, and creative labor force to develop and implement them – are crucial to Canada's economic progress. And, as material prosperity grows, Canada needs a well-educated and thoughtful citizenry to ensure the improvement of the country's more general social and political well-being. Our universities are major producers of ideas and of educated people, and anyone concerned with the quality of Canadian life – not least policymakers intent on improving it – must pay careful attention to this vital sector.

This volume brings together papers presented at a C.D. Howe Institute-sponsored session of the July 2001 meetings of the Canadian Economics Association in Montreal. Together, they provide an overview of the current state of affairs in Canada's universities. They discuss some the challenges these institutions now face, analyze their success in meeting them, and offer suggestions about policies that can encourage universities to enhance their contribution to the economy and to Canadian life more generally.

David Laidler, the editor of this volume, is Bank of Montreal Professor at the University of Western Ontario, and a Fellow-in-Residence and Canadian Bankers Association Scholar at the C.D. Howe Institute.

ISBN 0-88806-537-X
ISSN 0832-7912
$23.95

ISBN 0-88806-537-X